Mined Rock and Overburden Piles

Failure Runout Characteristics, Volume I

Interim
Report

March, 1992

British Columbia
Mine Waste
Rock Pile
Research
Committee

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Golder Associates Ltd.
CONSULTING ENGINEERS

INTERIM REPORT
TO
DEPARTMENT OF SUPPLY AND SERVICES
CONTRACT NO. 23440-0-9198/01-X8G

RE
RUNOUT CHARACTERISTICS OF DEBRIS FROM DUMP FAILURES IN MOUNTAINOUS TERRAIN

STAGE 1
DATA COLLECTION

VOLUME I
TEXT AND TABLES

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FOREWORD

Mine waste rock and overburden dumps are massive structures. Mountain top coal mines in British Columbia are constructing the largest man-made structures on the face of the earth. These immense waste dumps are often up to 400 meters high, contain in excess of one billion cubic meters of material, and often form mid-valley fills or rock drains. Instability of the structures has caused increased concern by mine operators and government regulators because of risk to the safety of personnel, equipment and infrastructure, and their impact on the environment.

In mid-1990 representatives of industry, CANMET, and the Ministries of Environment, and Energy, Mines and Petroleum Resources formed the Mine Waste Rock Pile Research Committee to foster research work and ensure a common understanding of these waste dumps.

The Interim Guidelines, published in May 1991, were the first two documents in a series undertaken by the committee. Three Interim Reports (Methods of Monitoring, Failure Runout Characteristics, Volumes I and II, and Review and Evaluation of Failures) continue the series of studies directed at improving our understanding of behaviour and developing a consistent database for waste dumps. Prominent geotechnical consultants and industry representatives have contributed their expertise to the studies.

The interim studies are being widely distributed by the Ministry of Energy, Mines And Petroleum Resources in the hope that all concerned with mine dumps will find them useful in establishing dumps that are stable, safe, and economically feasible. I anticipate that the studies will be distilled in the next year to develop a standard for investigation, design, operation, and monitoring of mine dumps.

In April 1992 the committee is sponsoring a series of workshops to introduce all of the studies to key industry personnel.

Tim Eaton, P.Eng.
Geotechnical Manager
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March 6, 1992

RESEARCH PROJECTS COMPLETED BY THE COMMITTEE

Investigation and Design Manual	(1991)
Operating and Monitoring Manual	(1991)
Methods of Monitoring	(1992)
Failure Runout Characteristics - Volumes I and II	(1992)
Review and Evaluation of Failures	(1992)

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1.0 INTRODUCTION

This interim report presents a compilation of available data on the nature of runout of debris from failed waste rock dumps. The focus of this study has been the coal mines of British Columbia where most of the major failures in the past decade have occurred.

Over 40 records have been assembled from information in files held by various mines and Golder Associates. The cooperation and assistance from contributing mines is gratefully acknowledged.

This interim report is submitted as Stage I of D.S.S. contract no. 23440-0-9198/01-X8G. Preliminary recommendations for Stage II of the project were submitted in Golder Associates letter dated May 3rd, 1991. Section 7.0 of this report makes further recommendations for execution of Stage II. During the course of Stage II of the study, it is anticipated that the data herein will be updated as new information becomes available.

All comments, suggestions, and new information will be gratefully received.

2.0 SCOPE OF WORK

Phase I of the study has included the following work:

- Collection and review of data on past failure events from various mines and in-house files.
- As required, visits to selected mines to collect additional data.
- Contact with selected mines, consultants, and government agencies to collect case histories of similar events.
- Compilation of a database for case histories including geometric information for both failure and runout aspects, and information on possible contributing factors.
- A literature search.
- Comparison of collected data with other broadly similar phenomena such as natural rockfalls and debris torrents.

- Development of a program of study for analysis of data collected in the first stage of work.

3.0 METHODOLOGY

3.1 Available Records

The starting point for data collection has been the records compiled by Golder Associates in 1987 as part of the project entitled a "Regional Study of Coal Mine Waste Dumps in British Columbia". The record numbering system has been maintained in the current study to avoid confusion.

Additional data including topographic plans and photographs have been supplied or loaned by various mining companies.

3.2 Data Assembly/Processing

Record Selection From a pool of over 160 dump failure events, the number of records with sufficiently clear documentation has been reduced to 42. A major component of the data base is written description of failure events. Unfortunately very few dump failures have been observed or investigated in detail immediately after their occurrence. We recommend strongly that any users of this database keep these deficiencies in mind when considering analysis of the numerical data.

Spreadsheet Summary Tables 1 and 2 are spreadsheets which respectively document the factors contributing to dump failures and their runouts. In addition, Table 2 presents geometric data obtained from the plans and profiles for each selected event. These geometric parameters have been selected for ease of comparison with data collected by others for natural mountain rock avalanches, and debris torrents.

Surficial Soils In most cases data and information on the nature of the surficial soils mantling runout paths have not been available from the files reviewed. Based upon our experience, and various geotechnical reports which provide general information on likely conditions, we have estimated conditions in the runout paths for most case histories. In a few cases, efforts have been made to probe failure debris but not in a systematic or comprehensive manner.

Topography Generally we have been successful in obtaining topographic maps showing conditions preceding dump failures. In areas where dumps have failed repeatedly, we have concentrated on documenting early occurrences since topographic records for later events are mostly unavailable or unclear. In a few cases topographic surveys have been carried out after a failure, usually by aerial photogrammetry. Caution is advised in the use of this information since most surveys of original ground contain errors due to forest cover. Desirable, but almost completely absent from available data, are detailed terrestrial surveys and the results of probings of or through the failure debris. However, the shape of topography in a runout path is quite well depicted in many maps of natural topography. This provides important insight into the nature of the runout occurrences, for comparison with other broadly similar phenomena.

Transverse Cross-Sections For simplicity we have classified the typical transverse cross-section of a runout path into three groups. Confined runouts include those where debris clearly has been constricted by sharply incised topography. Unconfined runouts are those where the failure debris has advanced onto topography that is essentially planar. Partly confined debris runout paths include those where the distal portion spreads onto a plain or fan, having earlier been confined. Other partly confined paths are gently curved swales where the influence of confinement appears to have been less prominent.

Longitudinal Sections Longitudinal sections have been selected to generally pass through the centre of the slide path, usually coincident with the axis of a water course or gully. The locations of the sections are shown on the accompanying topographic plans. The longitudinal sections have been digitized using Lotus 123, and converted into ASCII files. For this report the ASCII.DAT files have been plotted using the program GRAPHER. Two common scales have been used, dividing the data base into those with runouts of less than about 1,500 m, and those with longer runouts greater than 1,500 metres.

Runout Path Slope The runout paths have been classified into linear, curved, or deflected shapes. Linear runout paths may or may not conform to the shape of the underlying natural topography. Curved paths are influenced either by natural topography or an obstacle such as a pre-existing failure deposit. Deflected paths refer to a significant change in direction of travel due to impact with the topography of the runout path.

Photographs Aerial and terrestrial photographs have been obtained or loaned by various mines. In some cases stereographic pairs are available for natural and/or failure topography. Selected photographs are included in this report. However, it is recommended that other file photographs be reviewed during any future detailed analysis of individual events.

Weather Records All of the documented events have occurred in mountainous terrain where weather conditions are often extremely localized. It is suggested that, in most cases, only general correlations between weather records and dump failure occurrence should be sought.

Failure Documentation Tables 1 and 2 are accompanied by explanations of the listed parameters. The data in table 1 are included as an important documentation of the complexity of factors contributing to dump failure. Clearly, the nature of release of material by a failure is essential for any comparison or analysis of its subsequent runout. Again, we recommend that any future detailed analysis of individual events should include full review of the data-files.

3.3 Computer Data Base

As part of data collection, we have created a computerized data base using the program dBase III. A significant portion of the entered data cross-correlates with entries on Tables 1 and 2. The dBase records do contain more descriptive information which we consider essential to developing accurate and valid characterization of dump failure events.

3.4 Literature Search

This task included a search, by a qualified librarian, of North American data bases. This search did not yield any relevant case histories.

In addition, we have contacted various offices of Golder Associates in North America, Europe, and Australia with requests for information on any events, natural or man-made, which are broadly similar to failures experienced at mines in British Columbia. These requests have been quite specific by describing failures as involving relatively coarse waste rock supported on steep mountainous terrain. As a result of these enquiries we have not found any relevant case histories except for data from one mine in the U.S.

Considerable information has been published concerning failure and debris runout in natural mountain environments. Detailed documentation of this literature is beyond the scope of Stage I of this project. However, Section 6.0 of this report discusses the relevance of natural rock slides to the waste rock dump failures documented herein, Similarly, information on debris torrents is discussed in relation to these waste dump failures.

4.0 FACTORS AFFECTING DUMP FAILURE AND RUNOUT

This section briefly summarizes the range of conditions which may contribute to the failure of waste dumps in mountainous terrain and to the nature and extent of consequent runout of slide debris.

4.1 Dump Failures

Factors affecting the failure of waste dumps at coal mines in British Columbia were documented and discussed in the 1987 Regional Study of Coal Mine Waste Dumps. Subsequently, these factors have been addressed in the following studies:

- Design Guidelines for Investigation and Design (interim document currently being published by M.E.M.P.R.);
- Waste Dump Operational Guidelines (interim document currently being published by M.E.M.P.R.);

- Review of Past Major Waste Dump Facilities (work in progress);

Table 1 lists the elements for which data are desirable in assessing stability of waste dumps. It should be recognized clearly that some potentially important data such as rate of loading and quality of waste rock often are not available, and must be estimated.

4.1.1 Foundation Slope

Most of the waste dump failures have occurred where the toe of, if not all of, the base has been supported on slopes exceeding 20 degrees. The indicated factor of safety against base sliding is commonly less than 1.3 where base slopes are steeper than 20 degrees.

4.1.2 Foundation Topography

Three dimensional features such as gullies appear to have a significant effect on stability. Additional shearing resistance is derived through wedging action in sharply incised gullies. This effect is important when establishing dumps on steep terrain. Also, it is evident that the shape of the longitudinal profile affects stability. Vertical profiles have been classified into three groups in Table 1.

4.1.3 Foundation Soil Conditions

In general, waste dumps in mountain terrain in B.C. are supported on broadly similar foundation soils. These soils typically consist of colluvial materials, derived in part from the coal bearing sedimentary strata, which may overlay glacial till or bedrock strata. Both the colluvium and glacial till soils are considered to be competent materials. High mountain waste dumps have not been advanced deliberately onto deposits of weak saturated fine grained soils.

Analysis of several failures in the 1980's has indicated that excess pore pressures have developed within foundation soils or weathered rock strata. The excess pore pressures are considered to result from large shear strains caused by a combination of steep foundation slope and high rates of loading.

Possibly, winter freezing of foundations, prior to loading may be a factor in some failures.

4.1.4 Waste Rock Materials

Documentation of the quality of waste rock consigned to dumps is not precise but various visual observations have been noted in Table 1. Most operations avoid incorporating significant quantities of snow or mud into dumps, except in zones where there will be minimal impact on stability. However, it is clear that several dumps have failed due to the presence of a relatively large proportions of fine grained waste material which has become saturated. Also, sliver failures may occur due to oversteepening near the crest of the dump if excessive amounts of fines are present.

4.1.5 Operational Factors

On steep terrain, operational factors such as the control of the rate of loading and direction of dump crest advance are important. Relatively high rates of loading may result in accumulation of pore pressure due to large shear stresses within the dump foundation.

Certain designs of dumps depend for stability upon defined strategies of crest development being followed. Deviations from such carefully planned strategies may result in a dump face advancing onto very steep terrain.

4.1.6 Climatic Factors

The data presented in Table 1 indicate that more failures have occurred during winter and spring seasons than during summer and fall. In some cases persistent supply of water, such as during spring thaw, may have greater impact on dump stability than individual storms. Table 1 provides information on climatic conditions preceding dump failures. In addition, daily records of rainfall and temperature have been included in the data base. We note that actual conditions at an individual dump site may be different from those recorded at the nearest weather station. However, regional conditions such as spring thaw are expected to be reliably represented.

4.1.7 Modes of Failure

Other studies listed earlier have described various observed modes of failure. Almost without exception, failure is preceded by noticeable deformations of parts of a dump face. These observations have not been well documented but it is clear that complex patterns of strain occur within some dumps supported on steep terrain.

Typical analyses of stability of waste dumps focus on potential mechanisms with a curvilinear profile. In simplified terms the analyses model the stability of the toe of the dump, driven by the slumping mass of material in the upper part of the dump.

As noted earlier, there are few eye witness accounts of waste dump failures. As a result the rate of failure is usually uncertain. However, in some cases it is obvious that high velocities have occurred as evidenced by super-elevation of debris along the runout path.

Where available, comments on the mode and rate of failure are included in Table 1 and the dBase case records.

4.2 Dump Failure Debris Runout

Factors which potentially may have some effect on the nature or extent of runout of debris supplied by waste dump failures are discussed in the following sections.

4.2.1 Nature of Dump Failure

Waste dump failures vary from "explosive" releases on steep mountain side slopes to gradual slumps. The failures release relatively small or large volumes of debris depending upon the type of failure. Failures of slivers on the upper part of dump faces involve relatively small quantities of material.

Failure of an oversteepened toe of a dump may result in an instantaneous steep scarp which subsequently collapses, releasing a relatively large amount of potential energy.

Unfortunately few dump failures have been observed, and the dynamic aspects are not understood clearly. Thus, a significant unknown in the analysis of debris runout is the momentum or energy of the released failure mass.

4.2.2 Runout Path Profile

Typically, vertical profiles along the central region of runout paths have a concave shape. Table 2 lists several geometric parameters which have been tried by various researchers as a means of characterizing the zone of deposition. The slope of the deposition zone is generally less than 15 degrees, and may be less than 5 degrees, particularly if saturated organic soil exists in the runout path.

4.2.3 Surficial Soils

Surficial soils in the runout path vary from thin veneers of colluvium on bedrock to organic silt and clay. The degree of saturation of soils in runout paths can be expected to vary according to seasonal conditions. It is reasonable to assume that following spring thaw the degree of saturation of soils in the runout paths will reach maximum values.

The rate of loading imposed by advancing slide debris can be considered as rapid in most cases, except for very gradual slumping or creep failure. The effect of rate of load application on soil shear strength depends upon the relative density of the soil. If the soil is saturated, or has a high degree of saturation, excess pore fluid pressure will develop if the soil structure tends to contract when loaded. A large reduction in soil shear strength will occur if its permeability is low, and the over-riding slide debris may shear off the affected soil. The resulting effect is a lowered resistance to sliding applied to the slide debris. This effect may not be distinguishable, practically, from other phenomena of reduced base sliding resistance inferred from investigations of major natural rock slides.

The nature of surficial soils in the runout paths of events documented herein generally are estimates based upon experience and limited comments in the files.

4.2.4 Failure Material Quality

Typically, waste rock consigned to waste dumps may have a broad range of gradations. Specific measurements are limited, but available data was presented in the 1987 Regional Study of Coal Mine Waste Dumps.

In general most waste rock contains a significant proportion of large particles which segregate, and accumulate in the toe region of the dump face. Thus, there is a general tendency for the base of dumps to be well drained.

There are several failure events where a significant portion of a dump appears to have comprised saturated fine grained waste. However, the majority of failure debris is considered to comprise relatively coarse particles with a low degree of saturation.

4.2.5 Runout Paths Topography

It is evident that a large proportion of failure runouts are affected by topographic features. This corresponds to the morphologically young nature of the terrain.

In this aspect the runout paths are similar to those for debris torrents in steep areas disturbed by forestry and subject to flash flooding.

In some cases a confined runout path will open out onto broad planar topography. Spreading and thinning occurs and the debris decelerates.

4.2.6 Volume of Failure

The volume of material involved in waste dump failures spans approximately two orders of magnitude from about 50,000 cubic metres to 5,000,000 cubic metres. Most failures have involved less than 1 million cubic metres. Thus, the volumes of waste dump failures fall at the lower end of the range of natural rock slides, and are in the upper part of the range for debris torrents.

5.0 DATA FOR MINES IN BRITISH COLUMBIA

This section briefly describes the data typically obtained for the failures and runouts documented in this report.

5.1 Dump Failure Data

With reference to Table 1 the following statistics are evident:

- Over 80% of events occurred where the toe of the dump exceeded 20 degrees
- Dump face heights for failure events fall in the following intervals:

  2% < 100 m
  100 m < 39% < 200 m

  200 m < 52% < 300 m
  6% < 300 m

- Approximately 25% of failures are reported, or are suspected to have been affected by poor quality waste rock.
- Volumes of waste rock debris fall in the following intervals:

  37% < 250,000 cu m
  250,000 < 42% < 1,000,000 cu m
  1,000,000 < 19% < 5,000,000 cu m

- Arbitrary division of seasons indicates that more failures occur in winter and spring than in the summer and fall seasons:

Winter	(November - April)	31%
Spring	(May - June)	36%
Summer	(July - August)	21%
Fall	(September - October)	12%

5.2 Failure Runout Data

The following sections briefly summarize the range of data documented for debris runout, as presented on Table 2.

- The distal portions of runout debris came to rest on slopes inclined at angles from 0 degrees up to more than 30 degrees. In two events the distal portion ran up a valley sideslope. Thus:

  5% ran up
  23% < 5 deg slope
  5 deg < 41% < 10 deg
  10 deg < 26% < 15 deg
  15 < 5% < 30 deg
  3% < 30 deg

- In 7 cases organic soil in the runout zone is suspected as having been present.

- Approximately 70% of runout paths were confined or partly confined.

- The Fahrboschung angle, alpha, varied within in the range of 10 to 32 degrees.

  A plot of angle alpha against dump face height is shown on Figure 1.

- The runout distances of debris beyond the toe of the pre-failure dump fall into the following ranges:

  27% < 500
  500 < 49% < 1,000
  1,000 < 12% < 2,000
  15% < 2,000

- Figure 2 shows the range of runout profiles. These profiles lie within a relatively small band of slope but vary widely with respect to distance of runout. For comparison, a typical profile of a debris torrent runout on the northwest pacific coast is shown on Figure 2. The debris torrent channel comprises a very steep initiation zone. The transition and deposition zones are broadly similar for both waste rock and debris torrent runout paths.

In summary section 5.0 has briefly summarized the available data for 42 case records. We advise caution in the interpretation of these statistics since several mechanism of propagation and retardation may apply to some or all of the cases documented.

6.0 DISCUSSION AND ANALYSIS

This section briefly reviews the characteristics of events such as natural rock slides, debris torrents and snow avalanches. Data collected for waste dump failure runouts are compared with some of the published information for these other events, which, in some instances, may be similar.

6.1 Events Similar to Waste Dump Failures

A variety of terms exist for sliding events which occur naturally. The majority of these events can be grouped into three classes: dry slope movements (sturtzstroms); wet slope movements (debris flows); and snow avalanches.

> **Wet slope movements** are referred to as debris flows, debris torrents, mudflows or debris avalanches. Debris torrents is the term used in this document, and can be described as the rapid movement of saturated soil, rocks, and other debris (e.g. trees) down a steep mountain channel. A typical runout profile is shown on Figure 2. Characteristic of this kind of movement is the apparently semi fluid nature of flow leading many researchers to model debris flows as visco-plastic fluids. Such "fluid" flow may be representative of certain waste dump failures involving saturated fine grained waste.
>
> In most situations, we consider that the mine waste material will not contain sufficient water to achieve a debris torrent condition. If the waste rock slide debris rapidly loads saturated sediments in the runout path, the volume of saturated sediments sheared and incorporated into the slide is not expected to be sufficient to cause the whole slide to behave as a debris torrent.
>
> Tables 3 and 4 summarize characteristics of debris torrents worldwide and on the west coast of Canada. Volumes of debris torrents vary from 450 to 300,000 cubic metres. As noted earlier, runout paths are steeper in the upper zones of initiation,

for debris torrents than for waste dumps. Travel distances for debris torrents varied between 600 m and 6 km.

The upper bound of runout of a failing dump possibly may be predicted by assuming a saturated mass which will behave like a large debris torrent. Clearly boundary conditions must be similar for conditions to be analogous.

Dry slope movements are sometimes referred to as sturzstroms (the term which is adopted here), avalanches, rockslides or rockfalls. There are a variety of causes for these movements including seismic activity and human activity (for example slope cuts for mines or roads). Changing groundwater conditions may be involved in the initiation of "dry" slope movements, but dry slope movements are different from wet slope movements in that the moving mass is clearly not a liquid flow, and the runout distance is commonly considered to be controlled by conservation of momentum and friction between the sliding mass and the slope. Sturzstrom initiation and runout appear to be similar to many "dry" waste dump failures, particularly in that the initiation is often the result of human activity. Unlike waste dump failures, however, which do not start as an intact block of material, sturzstroms typically begin as large quasi-intact rock masses which disaggregate during the fall and the sliding process. In particular, the term sturzstrom has been used to denote excessively long runout distance as the result of reduced base sliding resistance.

Snow avalanches are discussed only briefly here. Like naturally occurring slope failures, they also can be "wet" or "dry", and may exhibit many of the same features of their wet and dry soil and rock counterparts. A significant difference between snow avalanches and their soil and rock counterparts is the low density and large surface area of snow particles which results in a significant loss of momentum due to air resistance.

6.2 Data Comparison

A) COEFFICIENT OF FRICTION, H/L

Figure 3 shows a plot of the parameter, H/L, for the documented waste dump failures. These data show a slightly higher range of values of the parameter H/L than data compiled by Melosh (1987) for terrestrial, lunar and martian events, as shown on Figure 4. The data compiled for waste dump slides may suggest a trend for decreasing friction coefficient with increasing slide volume. These data can also be compared with a plot by Abele (1974) which covers a wider range of slide volumes, as shown on Figure 5.

B) EXCESSIVE TRAVEL DISTANCE

Figures 6 and 7 show plots of excessive travel distance plotted against failure volume respectively for waste dumps and data for various Sturzstrom events compiled by Hsu (1975).

Excess travel distance, L_e, is defined as runout beyond a point on the runout path where a line inclined at 32 degrees passes through the dump crest.

It is evident that data for waste rock dump failures broadly conforms with data plotted by Hsu. The linear upper bound plotted by Hsu for mobile Sturzstrom events could be modified credibly across the upper bound of data points for waste dumps.

Possibly significant is the point plotted by Hsu for a muddy sturzstrom at Huascaran. This event involved several million cubic metres, and the debris travelled almost 12 km. This event could be analogous to a large dump consisting of saturated fine grained soils and situated, probably, at a high elevation. In our experience large dumps, located at high elevations, are unlikely either to become fully saturated or to consist entirely of fine grained material.

C) COTANGENT OF RUNOUT ANGLE

Figure 1 plots the cotangent of the Fahrboschung or runout angle against dump face height. It appears that the data points should be divided into several families according to such factors as organic soil in the runout path or the presence of unusually large amounts of wet, fine-grained waste rock.

Figure 8 shows a comparison of data complied by Campbell and Shaw (1978) and Zovodni et al (1984). The data points on the upper curve were selected by Campbell and Shaw for failures of dry waste situated on steep terrain without the influence of weak material in the runout path. By contrast data obtained by Zovodni for Kennecott mine dumps on relatively flat terrain illustrates the existence of a separate family of data.

Figure 9 shows a modified version of Figure 1 with a logarithmic scale for runout angle. It is evident that quasi-linear families of correlation may exist, with upper bounds of the contingent of the runout angle corresponding to the most adverse of contributing factors.

D) DEPOSIT LENGTH

Davies (1981) has found an apparent correlation between deposit length, L*, and slide deposit volume. Figure 10 shows a similar trend for waste dump failures, in which deposit length is measured somewhat arbitrarily over the lower portion of the runout path profile. Although quite widely scattered, it is possible that selected families of data for waste dump failures may fit the trend proposed by Davies.

E) RUNOUT PAST 10% GRADE

Vandre (1985) has developed a relationship based on observation of debris torrents in Utah. He relates runout past the point, below which the runout path is flatter than a 10% gradient, with the difference in elevation between the dump crest and the 10% grade point.

The trend developed by Vandre is shown on Figure 11, together with data for B.C. mine waste dumps. It is apparent that most dump failures plot below the line plotted by Vandre. This trend indicates that the debris torrents studied by Vandre are less mobile than most reported dump failure slides. However, we note that the plot in Figure 11 contains only 18 points. The other 24 runout events stopped on slopes with a grade exceeding 10%. The volume of debris torrents may be 1 or 2 inches of magnitude smaller than of dump failures. This difference in slide volume may account for the apparent difference in the mobility of the debris torrents and dump slides.

In conclusion, the comparison of data for runout of mine waste dump failures in B.C. with data for debris torrents, natural rock slides, and other mines, shows that variations in contributing factors result in a wide range of outcomes. Selective categorization of families of data with similar combinations of circumstance may yield more clear distinctions in runout behaviour.

7.0 RECOMMENDATIONS

We have described a proposed work plan in our letter of May 3rd, 1991. This section provides additional and more specific recommendations for Phase II which may lead to practical prediction of runout.

The available database is not complete in terms of all of the parameters desirable for detailed numerical modelling of the various process. However, we consider that the database describes waste dump failure events in sufficient detail for a framework of numerical models to be developed.

A key recommendation is the enactment of a process by which future waste dump failures and their runout phenomena can be thoroughly investigated. Recent studies aimed at establishing a common approach to investigation, design and operation of waste dumps have provided guidance in standardizing reports of dump failures. Investigation of the nature of potential failure runout paths is becoming a standard feature of risk assessment required for approval of designs of waste dumps.

Detailed observations of waste dump failures, documented scientifically, are practically non-existent. Also, observations and measurements of the deformation of the faces of waste dumps are limited.

In parallel with modelling of runout we recommend that Phase II studies include analysis of the dynamic aspects of various observed modes of dump failure.

Further empirical analyses of the available data are required to establish families of phenomena. This Stage I report has made a preliminary comparison of dump runout data with the empirical work of others, yielding generally sensible results. However, more detailed categorization of data in the correlative plots is expected to show more clear trends. Until analytical models are developed and tested, empirical methodology is the only means of assessing risk for dumping schemes.

The database documents a limited number of estimates of velocity at certain points in runout paths. This stage 1 study has not re-analyzed the estimates of velocity. We consider that a careful review of available topographic data will reveal more events and locations where estimates of velocity are practical. This review likely will identify a number of sites, or portions of runout paths, where detailed site assessment may be worthwhile. Site assessment could include topographic survey and excavation of test pits through both debris and channel side slopes. Useful data may be derived from careful inspections even of quite old slide events where they have not been over-run by later slides.

Report prepared by

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AHK/DBC/ap

2NR\F92\AK-1413

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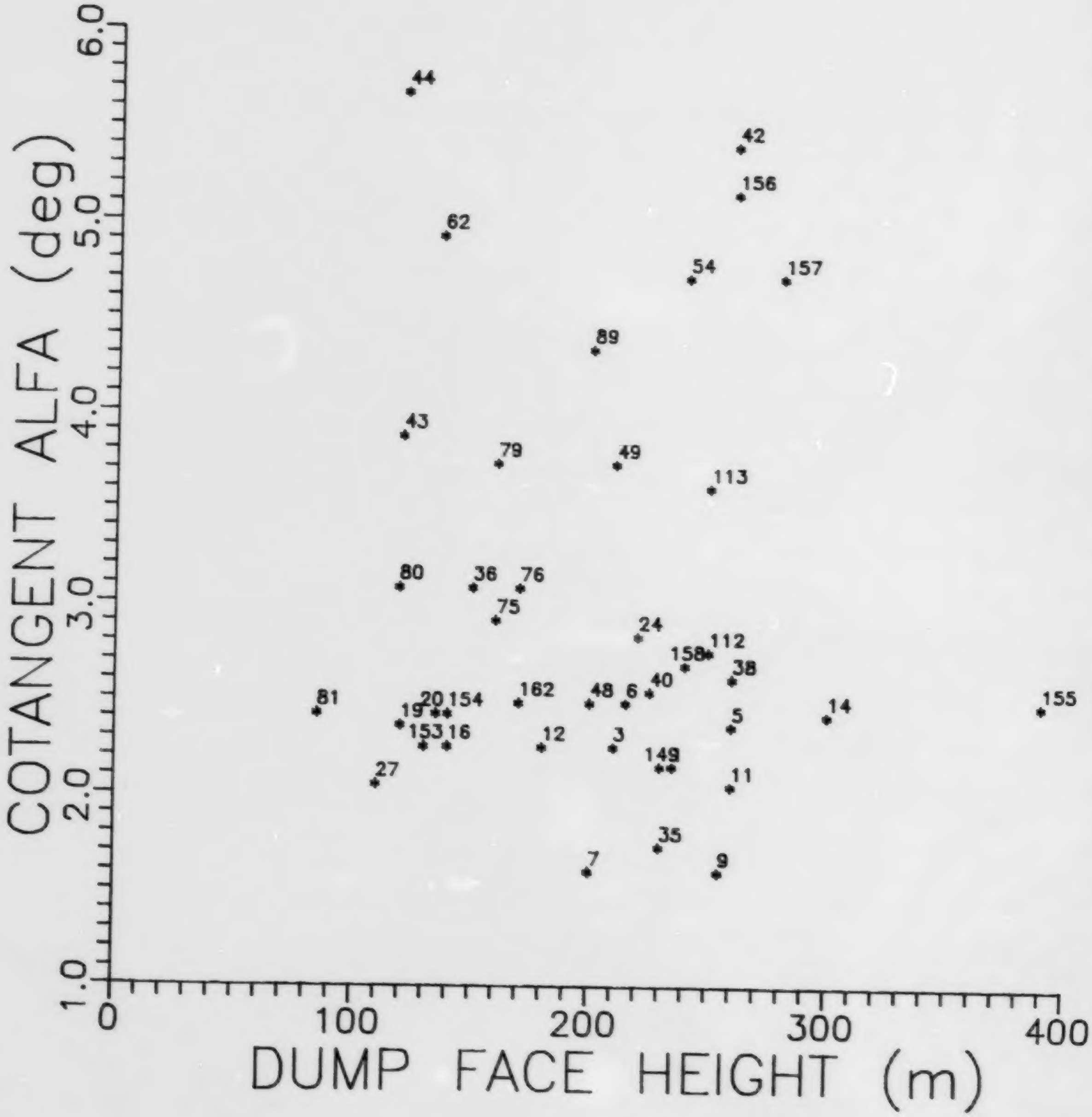
FARBOSHUNG ANGLE vs DUMP FACE HEIGHT

Figure 1



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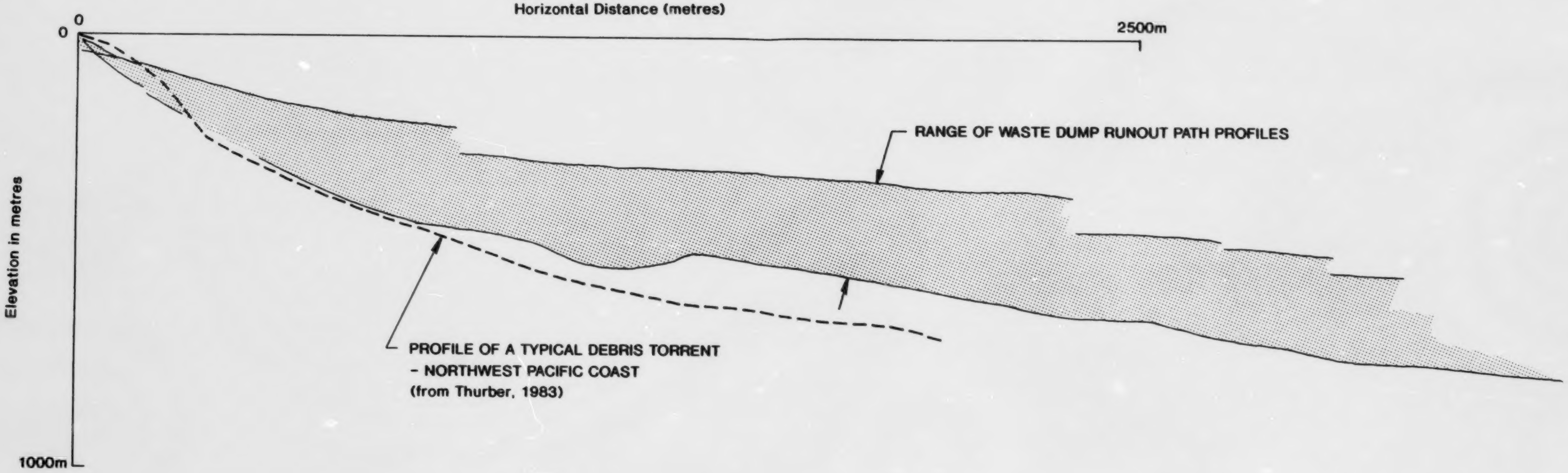
RANGE OF RUNOUT ZONE PROFILES

Figure 2



Approx. Scale: 1 : 10000

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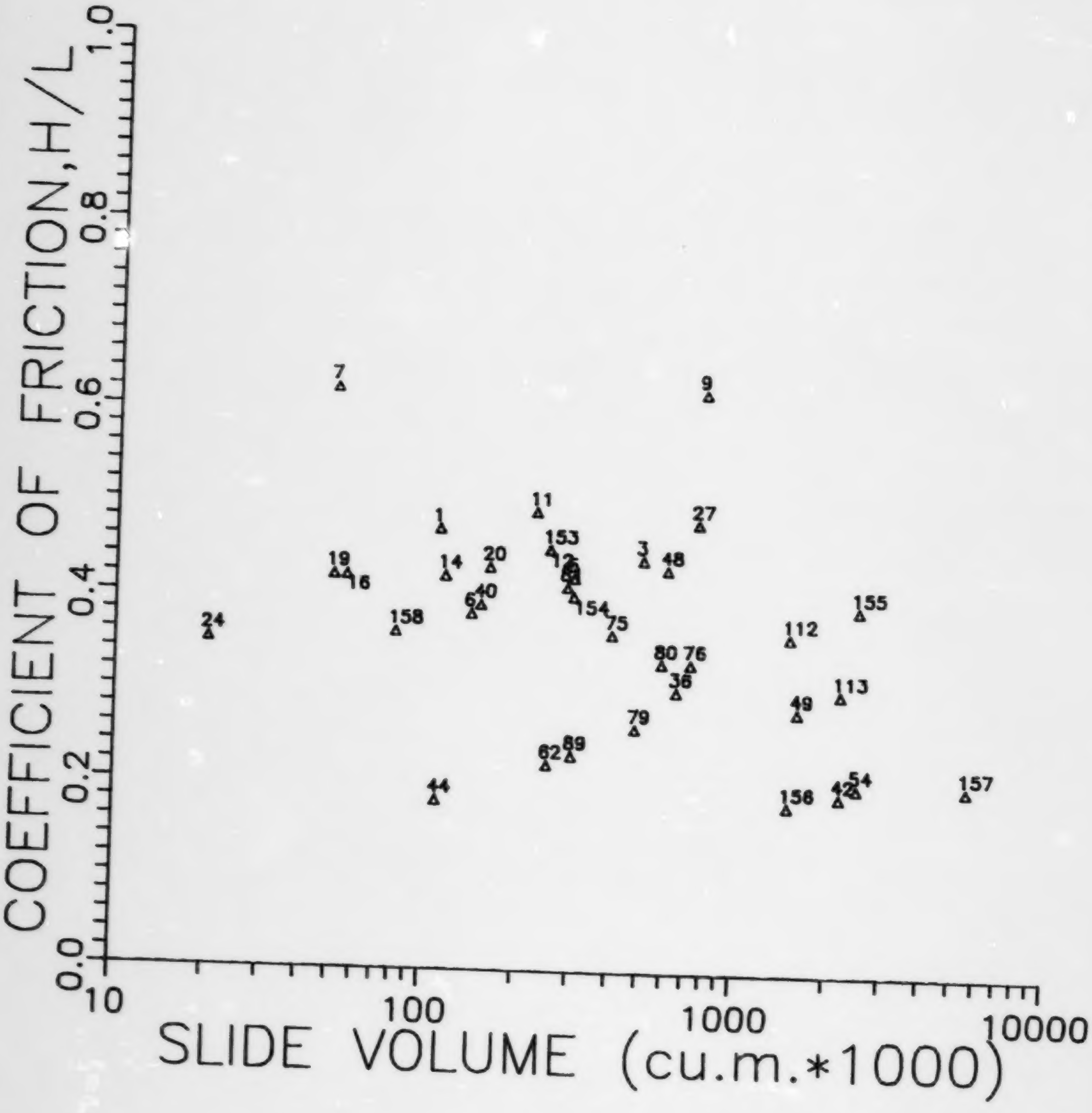
COEFFICIENT OF FRICTION vs SLIDE VOLUME FOR WASTE DUMPS

Figure 3



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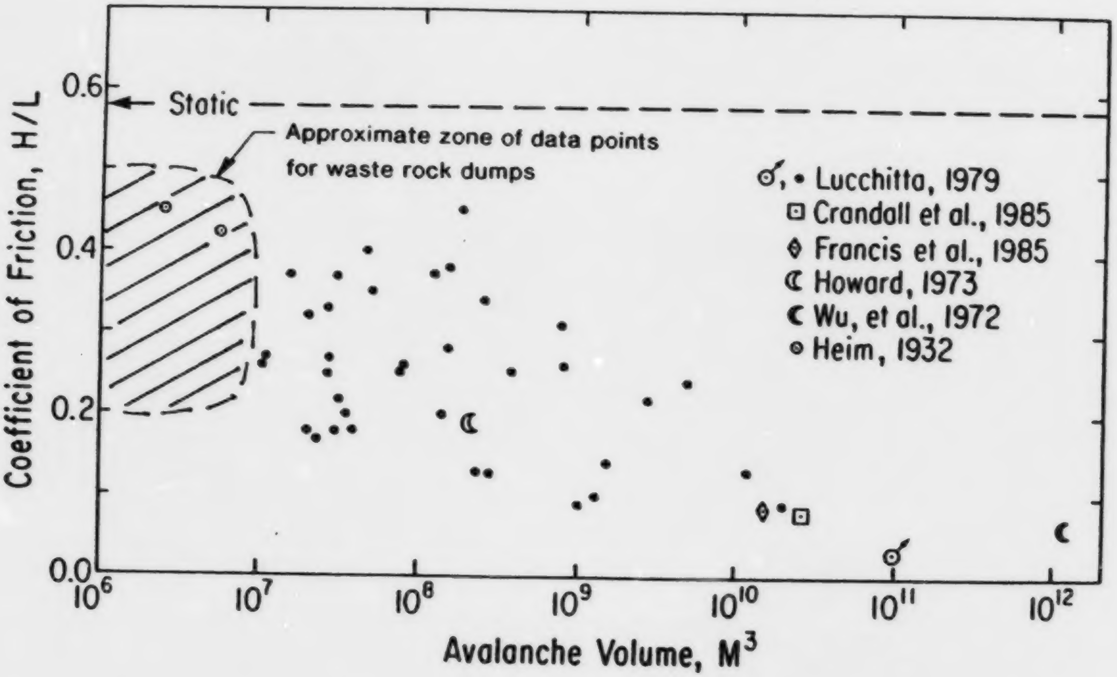
COEFFICIENT OF FRICTION vs VOLUME FOR TERRESTRIAL, LUNAR & MARTIAN ROCK AVALANCHES

Figure **4**



(after Melosh, 1987)

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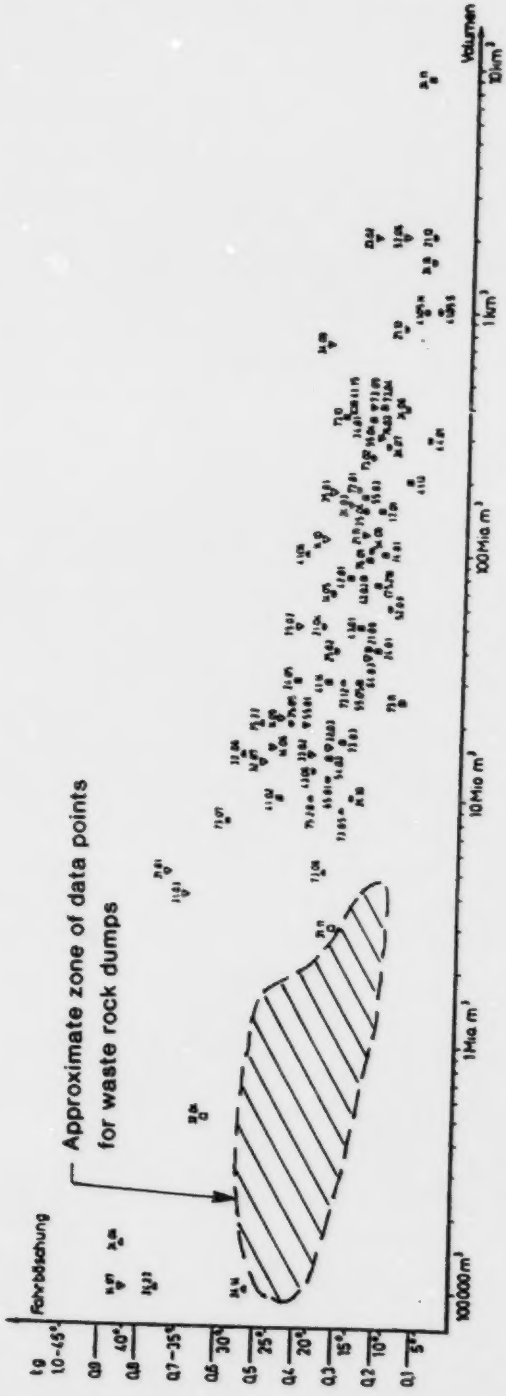
H/L VERSUS VOLUME

Figure 5



(after Abele, 1974)

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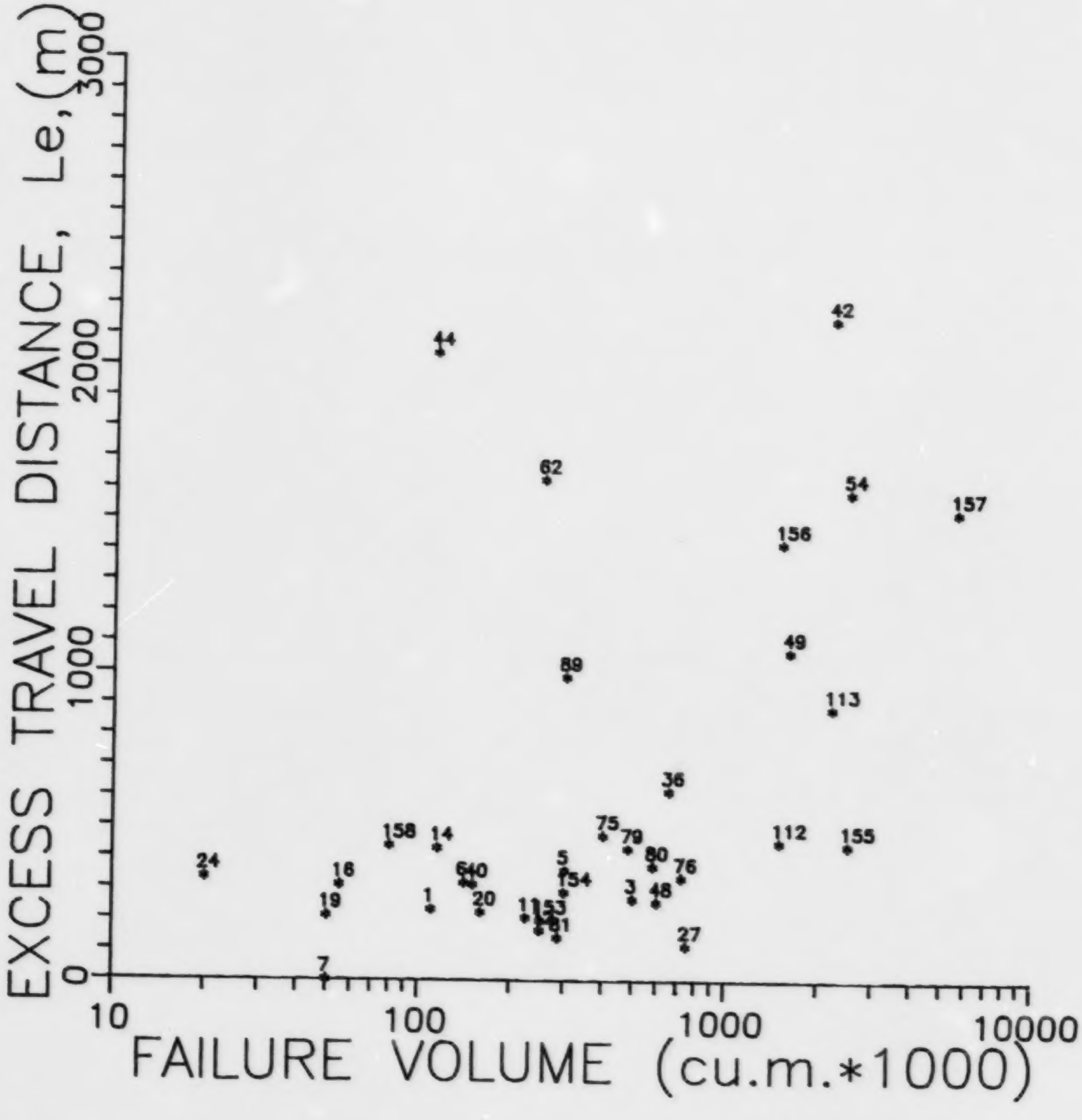
EXCESS TRAVEL DISTANCE, Le vs FAILURE VOLUME FOR WASTE DUMP FAILURES

Figure **6**



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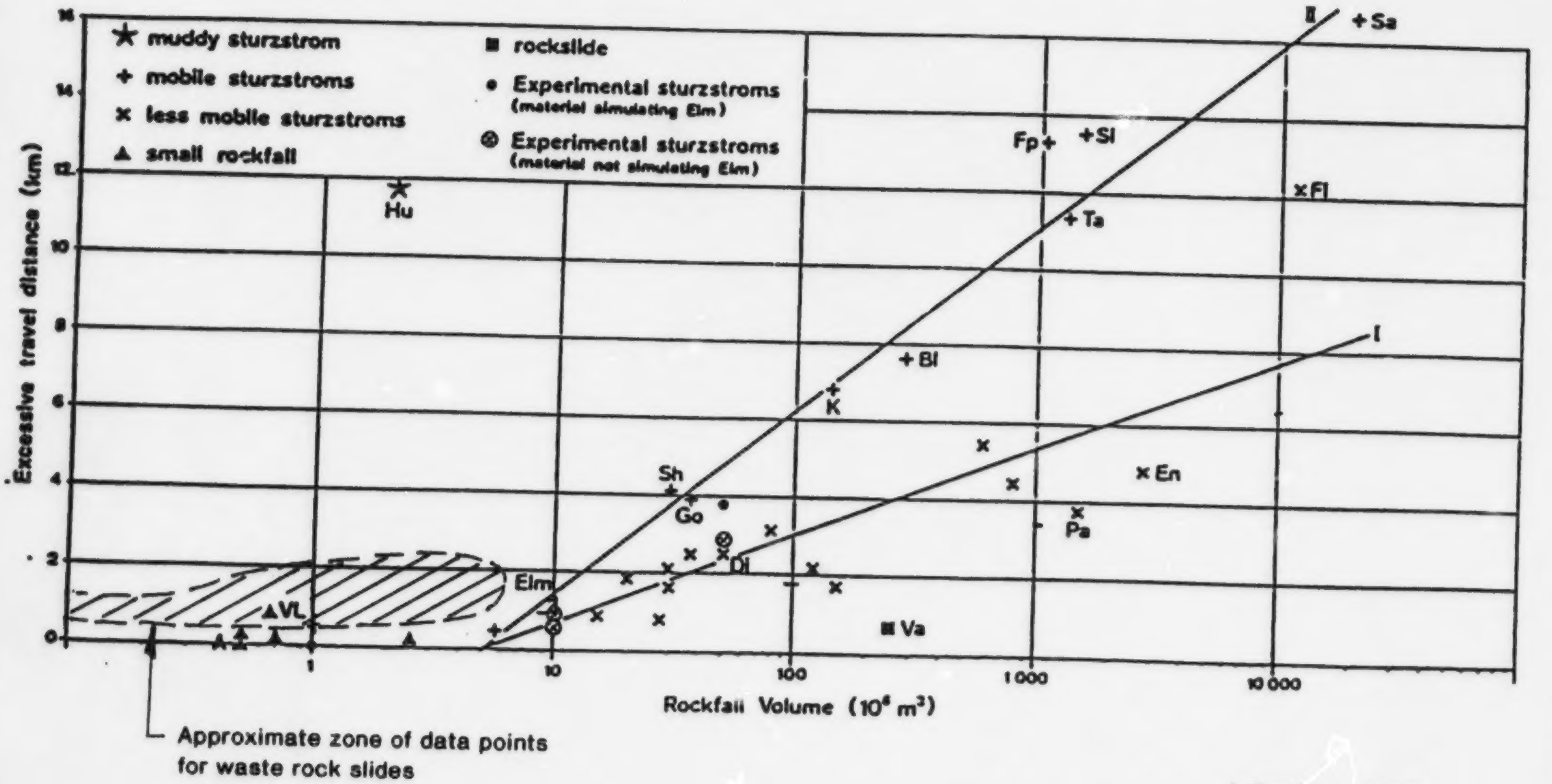
EXCESS TRAVEL DISTANCE, Le vs FAILURE VOLUME FOR MAJOR ROCK SLIDES

Figure 7

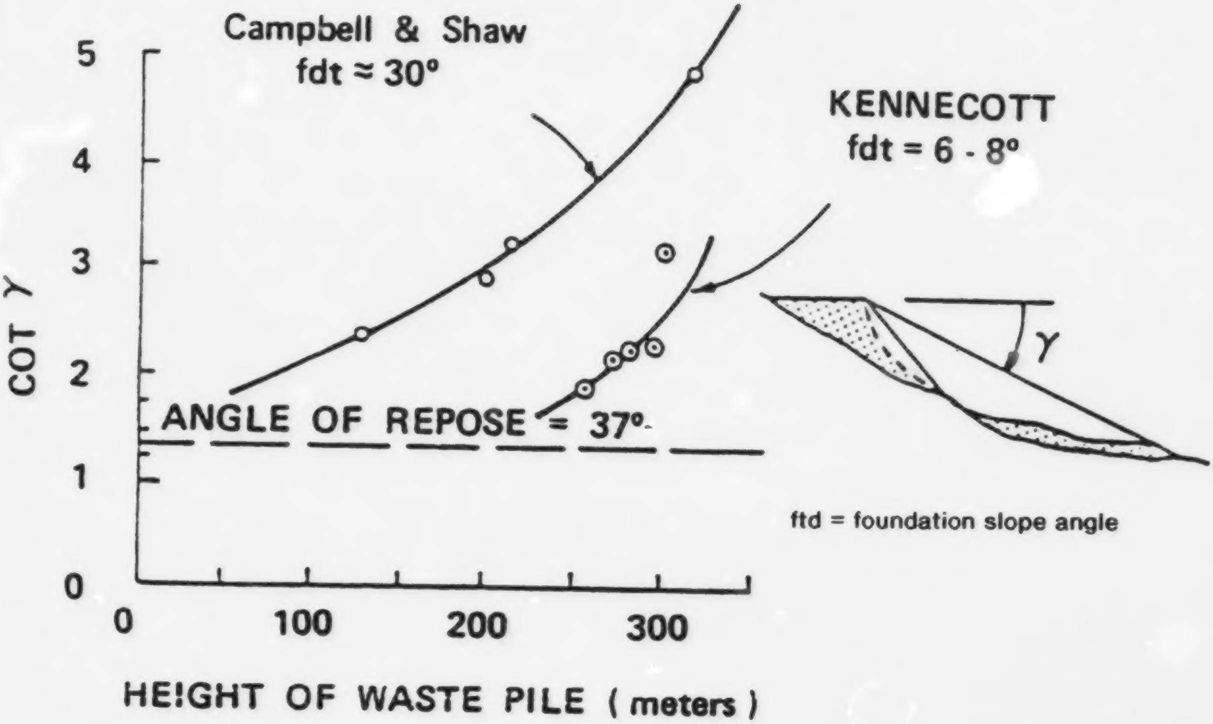
Abbreviations for the rockfalls are A, Airolo; VL, Val Lagone; Hu, Huascaran; Sh, Sherman; Go, Goldau; Di, Diablerets; K, Kandertal; Bl, Blackhawk; F, Fernpass; Ta, Tamins; Si, Siders; A 17, Apollo 17 on the Moon; Va, Vaiont; En, Engelberg; Fl, Flims; Fp, Fernpass; Pa, Palmira; Sa, Saidmarreh; Ts, Tsiolkovsky on the Moon.



(after Hsu, 1975)

COTANGENT OF RUNOUT ANGLE vs HEIGHT OF WASTE PILE

Figure 8



(selected data from B.C. and Kennecott)

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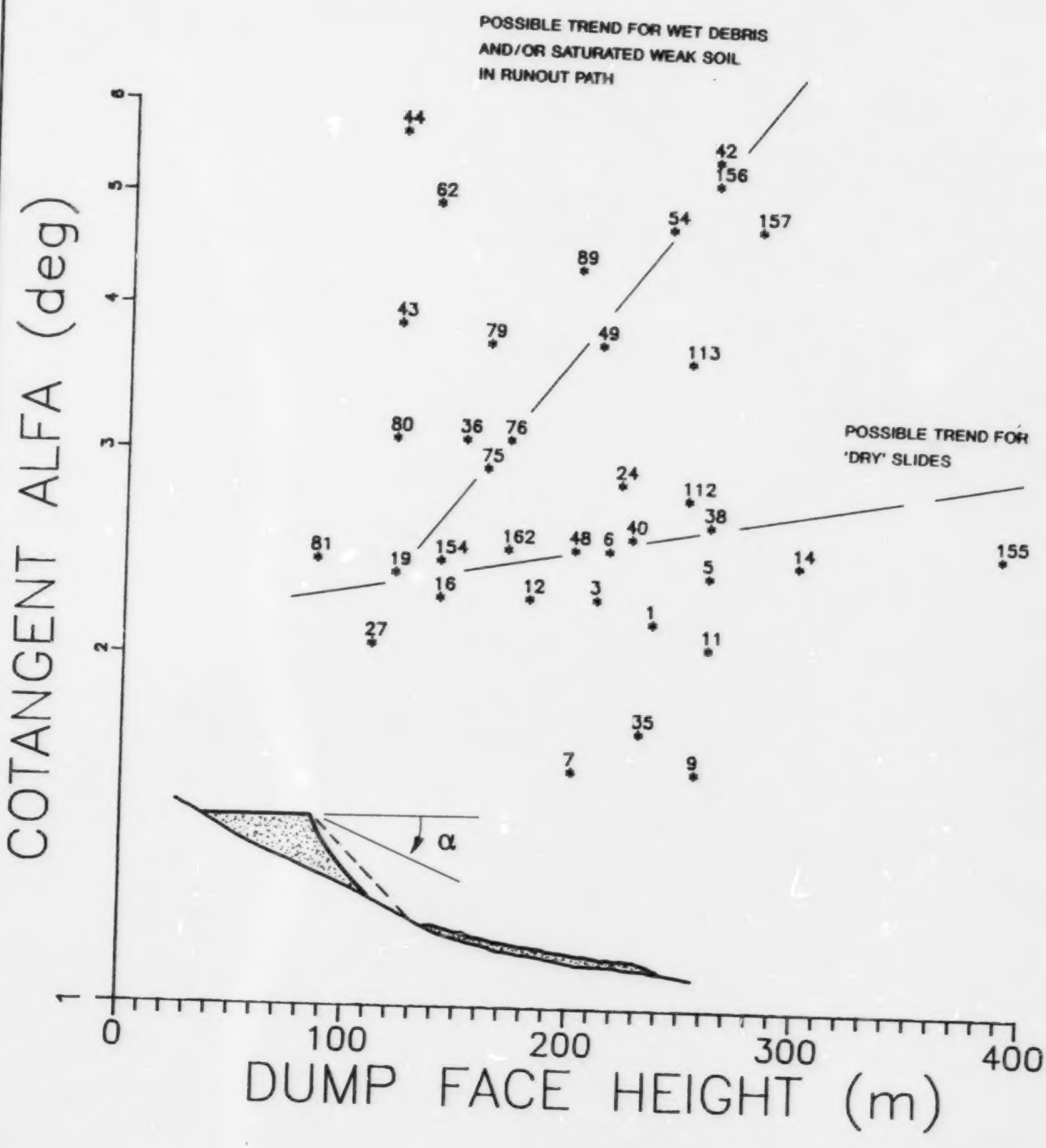
PLOT OF COTANGENT RUNOUT ANGLE vs DUMP FACE HEIGHT

Figure **9**



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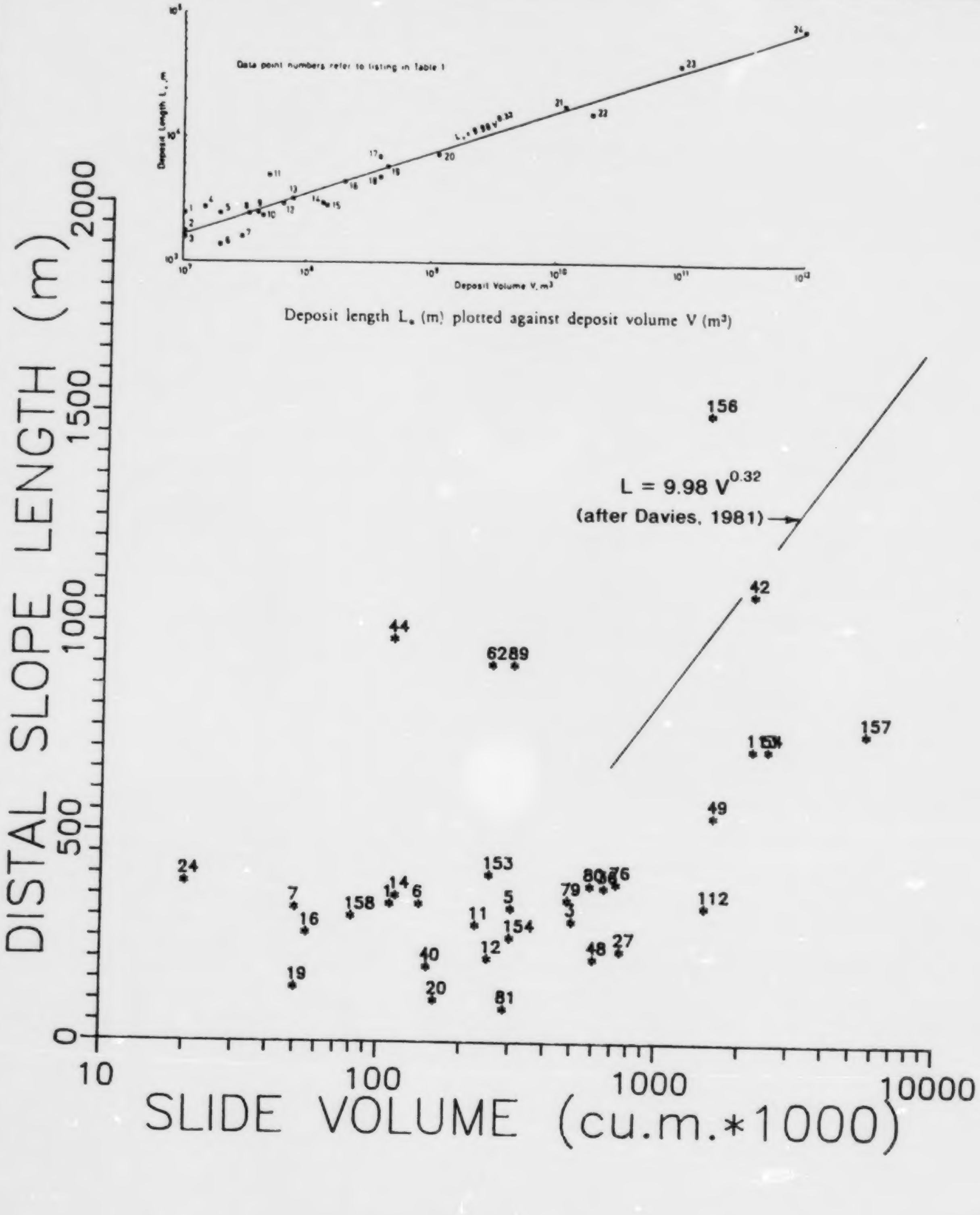
DISTAL SLOPE LENGTH vs SLIDE VOLUME

Figure **10**



Deposit length L_e (m) plotted against deposit volume V (m^3)

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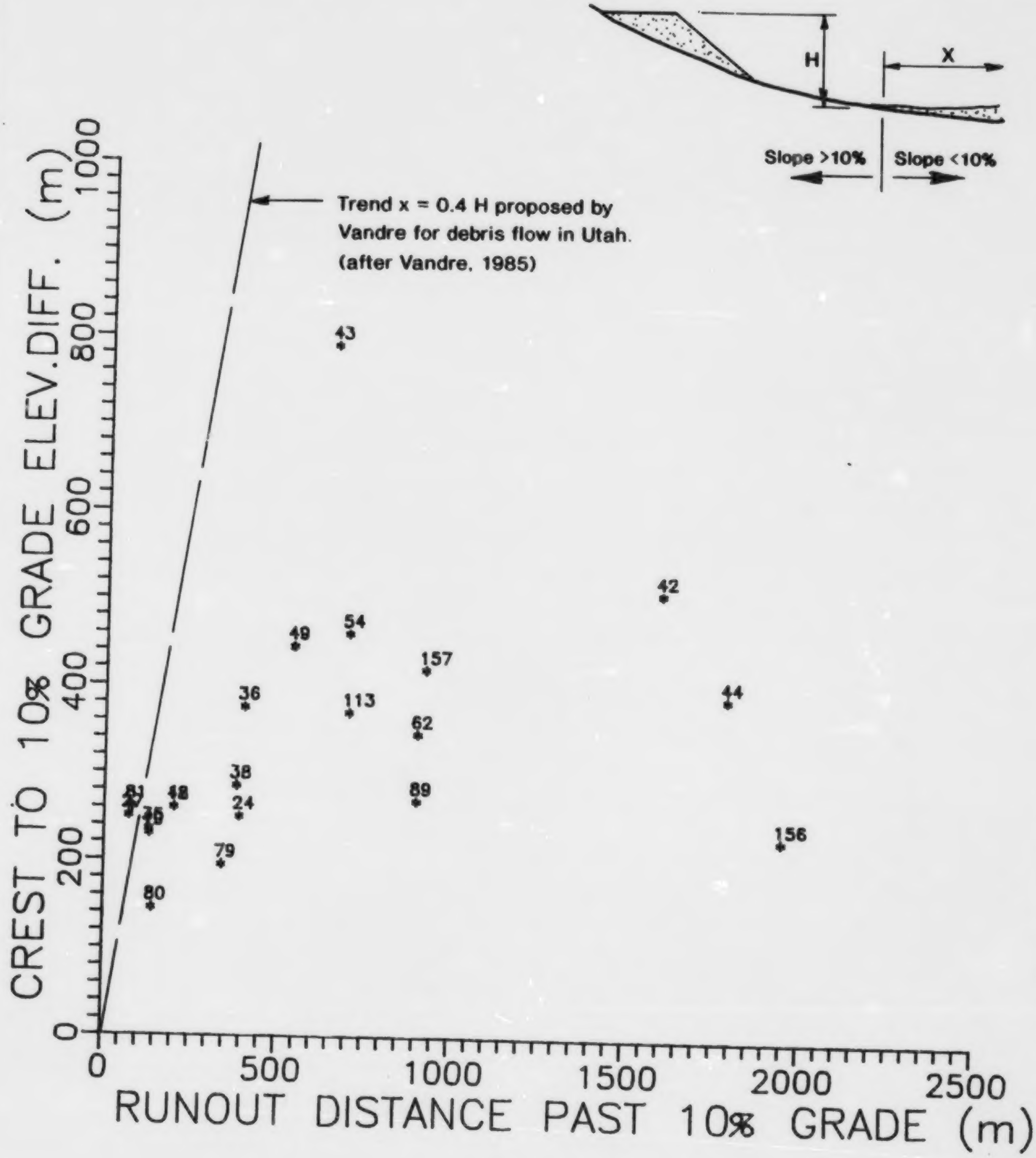
RUNOUT PAST 10% SLOPE BREAK POINT

Figure 11



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DATA BASE

MINE WASTE DUMP FAILURES

TABLES

Table 1: Data Summary for Dump Failure Events
Table 2: Data Summary for Failure Runouts
Table 3: Data Summary for Worldwide Debris Torrents
Table 4: Data Summary for West Coast Debris Torrents

CASE RECORDS

- Data Sheets (dBase III)
- Weather Records
- Digitized Profile Records

TABLES

Table 1: Data Summary for Dump Failure Events
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EXPLANATION FOR TABLE 1

Profile Type

A - Concave, slope decreases with decreasing elevation.

B - Convex, slope increases with decreasing elevation.

C - Planar slope.

Failure Rate

C - Slow creep failure - more than several hours to several days.

G - Gradual - say duration of 30 minutes to several hours.

R - Rapid - duration of less than 30 minutes, usually within several minutes.

3 - D Effect

Y = Yes Topographic shape of foundation considered to influence stability.

N = No

Foundation Material

C = Colluvium
R = Bedrock
T = Glacial Till
O = Organics
D = Previous slide debris
WR = Waste Rock
S = Saturated / Spring Discharge
F = Frozen

G. W. = Ground Water Conditions

Y = Yes Groundwater conditions considered a factor causing instability.

N = No

Dumping Information

Active ? A = Active dumping at time of failure.

Rate (BCM/M/DAY): Rate of dumping at time of, or immediately preceding, failure. Units are Bank cubic metres per metre of crest length per day.

RQ = Relative Waste Rock Quality

P - Poor, with a high proportion of fine grained soils including sand, silt, clay. Also includes significant amounts of carbonaceous material.

M - Moderate or average rock quality.

G - Good, with a high proportion of coarse, competent rock fragments.

Weather

? W - Y = Yes, Weather conditions considered to be a factor causing failure.

N - No.

PPT - Magnitude of significant rainfall preceding failure (mm).

PPT dT - Period of time preceding failure at which PPT occurred, in days.

Note: N.A. = Not available

Project No.:912-1413 updated February 24, 1992 by A. H. Kent

TABLE 1 – DATA SUMMARY FOR DUMP FAILURE EVENTS

EVENT	MINE	DUMP AREA	EVENT DATE	FAILURE DESCRIPTION		GEOMETRY			FOUNDATION PROFILE TYPE	3-D EFFECT	FOUNDATION CONDITION		DUMPING ACTIVE ?	RATE BCM/M /DAY	RQ	W?	WEATHER TEMP (C)	PPT (mm)	PPT dT TO FAIL (days)	REMARKS ON NATURE OF FAILURE
				RATE	MODE	TOE SLOPE (deg)	DUMP HEIGHT (m)	FAILED WIDTH (m)			MAT'L TYPE	G.W.								
1	FCL	BROWNIE	06/11/83	?R/G	TRANSL.	25	235	60	A	Y	CR	N	A			Y	12	HEAVY	9	NEAR 10 DAYS OF 0.9M/DAY DISPLACEMENT
3	FCL	BROWNIE	09/21/84	?R/G	TRANSL.	27	210	170	A	Y	CR	N	A			Y	7	HEAVY	0-3	PROBABLE CAUSE WAS STEEP TOPO,?AGGRAVATED BY PRECIPITATION
5	FCL	BROWNIE	07/24/84	?R/G	TRANSL.	28	260	100	A	Y	CR	Y	A			N	20	14	6-24	GW SEEN FLOWING FROM TOE A FEW DAYS EARLIER.DID NOT REACH CREST
6	FCL	BROWNIE	08/16/85	?R/G	TRANSL	24	215	N.A.	A	N	CT	N	A		P	Y		50	0-14	VERY STEEP UPPER FOUNDATION
7	FCL	BROWNIE	06/29/85	?G	SLIV	27	200	N/A	A	N	CT	N	A			N	15	0		HIGH WIRELINE RATES & SLIVER FAILURES ALL MONTH
9	FCL	2-SPOIL	01/30/84	C	TRANSL	10	255	N/A	A	N	F-S		A	60		N	-6	29		PORE WATER PRESSURE UNDER FROZEN CRUST
11	FCL	BROWNIE	09/16/85	?G	TRANSL	25	260	100	A	N	CT	N	A		P	Y		37	0-6	DUMP PROFILE ESTIMATED
12	FCL	13 SEAM	08/14/86	G	TRANSL	25-45	180	100	ABA	N	C/R	Y	I			N		10	4-6	GW SEEPAGE ON FACE; INACTIVE 3 MNTHS; TOE NOT INVOLVED
13	FCL	BROWNIE	11/23/86	R	TRANSL	28	290	N/A	A	Y	CT	N	A			S	>0			CREST UNAFFECTED;INACTIVE 2WKS;SNOWMELT;HIGH LOAD RATE
14	FCL	B-STONE	10/05/86	?R	TRANSL	29	300	150	A	Y	C/R	Y	I			S?	>0	SNOW	MELTING	FAILURE DID NOT INVOLVE TOE. INACTIVE 4 MNTHS. BLASTING AFFECTED?
16	FCL	BLACKRILL	06/17/85	R	TRANSL	33	140	80	B	Y	C/R	?N	I			M	10	21	10	DELAYED FAILURE.RAPID.SUSPECT BULGING FACE
19	FCL	2-SPOIL	05/05/72	?G	TRANSL	25	120	90	A	N	CT	N	A			S				VERY HEAVY SNOWFALL, BUT GROUNDWATER NOT FELT IMPORTANT.
20	FCL	2-SPOIL	05/27/72	R	TRANSL	25	135	300	B	N	CT	N	A			S				VERY HEAVY SNOWFALL, BUT GROUNDWATER NOT FELT IMPORTANT.
24	FCL	2-SPOIL	11/08/74	R	TRANSL	31	220	180	BA	N	C/T	N	A			N	0	50	OCT	RAPID FAILURE
27	FCL	2-SPOIL	11/12/74	C	SLUMP	20	110	200	ABA	N	O	WET	A			N	0	50	OCT	ORGANIC FOUNDATION SOILS.ORGANIC SOIL DISPLACED AHEAD
35	BLMR	H2 B3	11/18/80	C	TRANSL	35	230	N/A	BC	N			I			M	10	30	7-18	ABNORMAL BEHAVIOUR ON SEPT 13, 2 MNTHS PRIOR.
36	BLMR	A40-C1	06/29/82	R	TRANSL	25	150	200	AB	?Y	CT	?N	A			Y	20	40	0-6	RAPID FAILURE. RUNOUT WELL DOCUMENTED.
38	BLMR	5975	02/08/76	R	TRANSL	26	260	80	B?		C/T/R		A				3	69	FEB	LIMITED DATA AVAILABLE
40	BLMR	#2	11/24/68	R	TRANSL	32	225	N/A	A		T		A			Y		HEAVY	14	STEEP FNDN SLOPE, TRIGGERED BY HEAVY RAIN ONTO SNOW PACK
42	BLMR	A29-N	05/05/71	R	TRANSL	27	260	300	A	Y	T	Y	A			S		MELT		NO WARNING(?REPORTED).CLAY TILL, PORE WATER PRESSURE IN FOUNDATION.
43	BLMR	H KNOB	05/13/71	C?	TRANSL.	21	120	120	A?	N	C/R		A		P	S		MELT		RUNOUT WAS MUDFLOW FOLLOWING EARLIER DUMP SLUMP
44	BLMR	A29-S	05/25/73	R	TRANSL	35	120	N/A	C?	Y			A			S	16	MELT		STEEP TOE TOPOGRAPHY
48	QCL	1640 MM	06/21/86	?G	TRANSL	17	200	100	AB	N	C/R	Y	A	53	M	Y	20	40	6	HI LOAD RATES OVER PAST 3 MONTHS(160-390?).TOE BULGE.?FNDN PWP
49	QCL	1705 WN	06/30/86	R	TRANSL	28	210	150	BAB	N	C/D/R	N	A	74	G	?Y	20	40	15	FACE DEFORMATION DESCRIBED AS 'EXPLOSIVE'.
54	QCL	1660 N	09/09/85	R	TRANSL	20	240	500	A	N?	C/?T/R	Y	I	100	P	Y	10	45	4	FAILED WITHIN DUMP DUE TO WET FINES
62	LINE	1966 W	07/01/82	R	TRANSL	34	136	90	AB	Y	C/R	N	A			Y	?	HEAVY	0-2	STEEP TOE SLOPE.
75	GRHLS	EAST	03/20/83	?R	CIRC/TRANS	28	160	180	A	N	CF/SN/R	N?	A		P	N	2	0		STEEP TOE;POOR WASTE;OVERSTEEP FACE
76	GRHLS	EAST	05/11/83	?G/C	CIRC.	14	170	250	A	Y	C	?Y	A		P	S	9	34	MAY/JUNE	QUASI-CIRCULAR.EXCESS FNDN PWP.NOT STURZSTROM.POOR WASTE.
79	GRHLS	EAST	07/12/86	R	TRANSL	18	160	150	A	N	C/R	Y	A		P	N		32	0-14	POOR QUAL DEBRIS AT TOE;FNDN SEEPAGE;STEEP TOPO.
80	GRHLS	EAST	02/12/87	?R	TRANSL	35	119	200	B		CF/R;SN		A		P					POOR QUAL. DEBRIS AT TOE;STEEP TERRAIN;?AFFECTED BY PREVIOUS SLIPS
81	GRHLS	EAST	03/07/87	G	TRANSL	18	85	150	BA		S		A		P					POOR QUAL. DEBRIS AT TOE;FROZEN FNDN PUSHED AHEAD
89	GRHLS	NORTH	07/01/85	?R	TRANSL	24	200	350	A	Y	C/R	N	A		?P	N	20	2	14	SLIVER FAILURE;STEEP FNDN,POOR ROCK;HIGH LOAD RATE
112	QCL	1690MT	08/17/84	?G	?ROTAT.	17?	250	240	A	N	C/T/R	N;?Y	A	190	P	N	?	26	0-14	REGRESSIVE WITH SEVERAL DISTINCT SLUMPS
113	QCL	1690MT	10/04/85	?G/R	TRANSL	21	250	250	A	N	C/R	N;?Y	A	70	?P	Y	10	25	0-14	HEAVY PPT IN LAST 2 MONTHS NOTED.POOR ROCK.PREVIOUS SLIP.?OLD SNOW
149	FCL	BLAINE	06/16/86	G	TRANSL	15	230	N /A	A	N	F-CT	Y	I		G	N	20	NIL		?FROZEN FNDN OR STRAIN INDUCED PWP.
153	FCL	SS STG 2	05/29/90	?R	T	26	130	200	A	Y	C/R		I		?P			25+	4-7	STEEP FOUNDATION;?PWP IN COLLUVIUM;FINES IN WASTE
154	FCL	SS STG 2	07/07/90	?R	TRANSL	28	140	110	A	Y	C/R	?Y	I		?P	?Y		HEAVY	1	STEEP TOE;WET WEATHER CAUSES EXCESS PWP IN COLLUVIUM
155	FCL	SOUTH	10/26/89	R	TRANSL	23	390	230	A/B	Y	C/R		A	170				6	2-3	HEIGHT OF DUMP MAY CAUSE FAILURE THRU' WASTE ROCK
156	GRHLS	NORTH	11/22/89	R	TRANSL	30	260	N/A	A	N	C/R/O		?I	?LOW	?P			9	2-3	EXCESS PWP IN FOUNDATION ORGANICS
157	QCL	1660	11/07/87	?R	TRANSL	13	280	640	A	Y	C/R/D	Y	A	550	P	N		3	8	RUN OUT CHANNELED IN STREAM BED OVER PREVIOUS FAILURE DEBRIS
158	QCL	1680 WW	05/13/88	R	TRANSL	33	240	N/A	A/B	?Y	C/R	Y	A		P	Y		0	0-14	PORE PRESSURE IN COLLUVIUM;CREST STEEPENED TO 42DEG;DUMP FINES; SPRING THAW.
162	FCL	BROWNIE	06/01/83	?R	TRANSL	33	170	N/A	A		C/R							1	1	STEEP FOUNDATION

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EXPLANATION FOR TABLE 2

Volume (cu. m.) -		Generally an estimate calculated by mine operations of failed volume.
Width (m.) -		Estimated average width of distal portion of slide debris.
Distal Elev. -		Elevation of terminus of slide debris.
Runout Shape -	Linear -	Runout path approximately straight.
	Curved-	Runout path distinctly curved.
	Defl. -	Runout path prominently deflected by topogrpahic or pre-existing dump slide debris.
Distal Portion:	Grade -	Arbitrarily selected slope of slide deposition zone, below obviously curved transition from upper slope.
	Length -	Length of distal portion.
10% Grade:	Elev -	Elevation on runout path below which slope is less than 10 per cent.
	Distance-	Length of runout path beyound 10 per cent slope break point.
Surficial Soil:		Refer to Table 1.
Typical Cross-Section:		Describes typical transverse cross-section of runout path.
	Unconf.-	Unconfined: Broad valley or planar slope which does not obviously constrain slide debris.
	P.C. -	Part confined: Topography considered to have partly affected path of slide debris.
	C. -	Confined: Runout path clearly controlled by topography.
Velocity Estimate:		Superelevation in runout path provides a basis for estimation.

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TABLE 2 – DATA SUMMARY FOR FAILURE RUNOUTS

EVENT	VOL. (cu m) *1000	WIDTH (m)	DIST. FROM TOE (m)	DIST. FROM CREST (m)	FAHR-BOSCH. ANGLE (deg)	CREST TO DISTAL ELEV DIFF. (m)	RUNOUT SHAPE	DISTAL PORTION GRADE (deg)	DISTAL PORTION LENGTH (m)	CREST ELEV. (m)	10 % GRADE ELEV'N (m)	CREST TO 10% GR. EL.DIFF. (m)	RUNOUT DIST. FROM 10% BREAK (m)	SURFICIAL SOIL TYPE	TYPICAL CROSS-SECTION	COMMENTS ON RUNOUT NATURE	PHOTO. AVAILABLE	VELOCITY ESTIMATE VALUE (KM/HR)	DATA SOURCE
1	110	65	590	900	25.0	420	CURVED	15	330		N.A.		N.A.	C/T	P.C.	SMALL STURZSTROM	YES	N.A.	FCL Rep Jun 83,GA 8121258
3	500	250	640	925	24.0	408	LINEAR	14	290		N.A.		N.A.	C/T	P.C.	RAN OVER EVENT 1 DEBRIS.DISTAL PART SPREAD	YES		FCL REPORT;GA8121258
5	300	250	780	1125	23.0	470	?CURVED	8	320		N.A.		N.A.	C/T	C	TOE DEBRIS = FINE WASTE AND TILL	YES	N.A.	FCL REPORT UNDATED;GA8121258
6	140		610	950	22.0	360	LINEAR	11	330		N.A.		N.A.	C/T	P.C.	INITIALLY GRADUAL;TOE CREPT ALONG CREEK	YES	N.A.	FCL Rep.Sept 25 1985
7	50	?	310	580	32.0	360	?	32	320		N.A.		N.A.	C/T	P.C.	RUNOUT DATA IS ESTIMATED	YES		FCL INTERNAL MEMO
9	775	220	60		32.0											Written discription only	NO		GA 832-1158,FCL REP'T
11	225		560	910	26.0	450	LINEAR	12	280		N.A.		N.A.	C/T	UNCONF	GRADUAL SLIP OVERTOP EXIST DEBRIS	YES		FCL Rep.
12	250	150	210	550	24.0	250	LINEAR	0	200	2330	2070	260	200	C/WR	UNCONF	FAILED OVER 30MINS.	NO	SLOW	FCL Rep.
13	45		500													V. little data			FCL Rep
14	115	70	750	1250	22.5	525	CURVED	13	350		N.A.		N.A.	C/R/?T	CONF.	1990 SURVEY SHOWS DISTAL MOUND	YES	MAYBE	FCL Rep.
16	55	90	880	1120	24.0	475	DEFL.	10	260		N.A.		N.A.	C/T/R	CONF	ONLY 10,000LCM MOVED DOWN CHANNEL	YES	MAYBE	FCL Rep.jULY 5 1985
19	50	180	460	650	23.0	275	LINEAR	8	130	1930	1700	230	130	C/T	UNCONF		YES		GA V72112
20	160	280	480	630	22.5	270	LINEAR	8	100		N.A.		N.A.	C/T/WR	UNCONF	OVER-RODE HAUL ROAD EMBANKMENT	YES		GA V72112
24	N.A.	220	550	770	19.5	270	LINEAR	3	380	1950	1700	250	390	?O/T	UNCONF		YES		GA V74118
27	750	180	220	520	26.0	250	LINEAR	7	220	1950	1700	250	70	WET,ORG	UNCONF	GRADUAL;NOT DYNAMIC RUNOUT	YES-N.S.	N.A.	GA V74118
35		75	160	450	30.0	260		5	120	1865	1630	235	130	D/WR	UNCONF	PROBABLY A SLUMP OVER OLD SLIDE DEBRIS	NO		GA FILE;WESTAR FILE
36	650	200	1140	1370	18.0	415	DEFL.	5	370	1825	1450	375	400	C/T/R	CONF	SUPERELEVATED.GOOD RUNOUT ACCOUNT.	YES	72	GA FILES:WESTAR RECORDS
38		40	550	880	21.0	335	DEFL.	7	380	1865	1580	285	380	C/T/?R	P.C.	SHARP TURN	YES		GA V77087
40	150	100	620	850	21.5	330	CURVED	0	180		N.A.		N.A.	C/T	UNCONF.	RAPID	YES		GA V6880, V77151
42	2200	150	2600	3000	10.5	565	DEFL.	2	1070	2060	1550	510	1600	C/O	CONF	?RELATIVELY SMALL VOLUME RAN OUT	YES		GA Rep.V77151
43		120	3200	3360	14.5	870	DEFL.	6	650	2010	1220	790	650	C/T/R	CONF	EXPOSED DEBRIS NOT MUD.DISTAL PORTION=FAN.	YES	MAYBE	GA V77151;1986 INSPECTION
44	110	160	2500	2750	10.0	500	DEFL.	3	960	1950	1560	390	1790	C/T/R,O	CONF.	UNUSUALLY LARGE R/OUT DIST. ? DUE ORGANIC	YES		V77151
48	600	140	400	680	22.0	290	DEFL	7	200	1640	1380	260	200	D/WR	P.C.	NOT RAPID.FINE CARBONAC.WASTE IN DEBRIS	YES		QCL Rep.
49	1600	200	1750	1790	15.0	500	DEFL	6	540	1705	1260	445	540	D/WR	CONF.	FLOWED LIKE WATER;EXPLOSIVE FAILURE	YES	70-90	QCL Rep.
54	2500	550	2200	2500	12.0	510	CURVED	3	700	1660	1200	460	700	C/T/R	CONF	MAJOR EVENT.DISTAL WIDTH 50-100M	YES	MAYBE	Piteau FILE 923-15
62	250	180	2000	2200	11.5	490	DEFL.	6	900	1966	1620	346	900	CS	CONF	WET FNDN MAJOR CAUSE.NOT STURZSTROM.	YES	MAYBE	GA 832-1015, 812-1052B
75	400	250	850	1000	19.0	360	SL.DEFL.	RUNUP			N.A.			CF/SN	P.C.	RUNUP OPPOSITE SLOPE.STURZSTROM.	YES	MAYBE	GRHL Memo Mar 29/1983
76	720	175	380	680	18.0	225	LINEAR	7	380		N.A.			C/R	P.C.	NOT STURZSTROM.	NO		Westar report May 83,ref2.11#27
79	480	150	530	780	15.0	200	LINEAR	5	340	2245	2050	195	340	D	P.C.	RUNOUT OVER MAY '85 SLIDE DEBRIS.	YES		GA8621409;7921120,1120B
80	580	200	580	750	18.0	250	LINEAR	10	375	2145	2000	145	140	DS	P.C.	CHECK TOPO RECORDS	YES		GA7921120;86221409
81	285	150	290	415	22.5	170	DEFL.	2	80	2240	1980	260	80	C/R/F	P.C.	NOT A MAJOR RAPID EVENT	YES	SLOW	
89	?300	160	1200	1600	13.0	360	DEFL.	6	900	2100	1830	270	900	OS	CONF	FNDN ORG SOIL PUSHED 350M AHEAD	YES		GA 862-1409
112	1500	400	740	1070	20.0	390	SL.DEFL.	9	325		N.A.		N.A.	C/T	UNCONF	NOT A MAJOR RUNOUT EVENT			Piteau 923-11,aUG 23,1984
113	2200	300	1180	1480	15.5	440	LINEAR	6	700	1695	1325	370	700	C/T/R	UNCONF	TOE PUSHED TILL SLABS AHEAD;PREVIOUS EVENT	YES		Piteau 923-15 NOV '85
149	LARGE	FULL	210	510	25.0	250	LINEAR	11	220		N.A.		N.A.	C/T	UNCONF.	GRADUAL;STOPPED AGAINST TOE BERM	YES	1-2	GA 8121162,8621105,8621061
153	250	50	500	670	24.0	300	LINEAR	15	400		N.A.		N.A.	C/T/R	CONF.	DISTAL PORTION DEFLECTED	YES	?MAYBE	FCL Rep.
154	300	70	690	870	22.5	350	CURVED	14	250		N.A.		N.A.	C/T/R	CONF	RAN OVER PREVIOUS DEBRIS	YES	?MAYBE	FCL Rep., GA 902-1175
155	2500	650	850	1280	22.0	500	FAN	RUNUP			STEPPED			W/TS/A	UNCONF.	FANNED;MUCH OF DEBRIS CROSSED CREEK	YES	>100	GA 892-1266;8721036
156	1500	350	1950	2230	11.0	400	?DEFL	4	1500	2030	1800	230	1950	O/A	CONF.	UNUSUALLY FLAT RUNOUT-THICK ORGANIC SOIL	YES	?70	GA 892-1406 & A
157	5600	200	2200	2480	12.0	490	DEFL	3	740	1660	1240	420	920	C/T	CONF	Good info, air photos	YES		GA 872-1263
158	80	100	790	1110	20.5	405	DEFL	10	300		N.A.		N.A.	C/T/R	CONF	RAPID,FLUID-LIKE	YES		GA8821146A
162	?	60	870	1050	22	400	CURVED	10	420		N.A.		N.A.	C/T/R	CONF		YES	NO	

Note: Run out distance refers to horizontal distance measured along the centre of the run out path, from the pre-failure dump toe.

AHK/ak/kc : 2/L/TAB-91/SEP/AK-1413.wk2

TABLE 3

PHYSICAL CHARACTERISTICS OF DEBRIS TORRENTS FROM VARIOUS PARTS OF THE WORLD

Location, Year and Reference	PORT ALICE, B.C., 1975 Nasmith and Mercer (1979)	KICKING HORSE PASS, B.C.,1978 Jackson (1979)	STEELE CREEK, YUKON, 1967 Broscoe and Thomson (1969)	MAYFLOWER GULCH, COLO., 1961 Curry (1966)	GLENWOOD SPRINGS, COLO., 1977 Mears (1977)	WRIGHTWOOD, CAL. 1969 Morton & Campbell (1974)	LAKE TAHOE, NE. 1967 Glancy (1969)	M. THOMAS, N.Z. 1978 Pierson (1980)	KAMIKAMIHORI VALLEY, JAPAN, 1972 Ishikawa (1982)	VORON RIVER, CRIMEA, USSR, 1956 Gol'din and Lyubashevskiy (1966)	MARZENBACH, AUSTRIA Hampel (1977)
Event Magnitude(m^3)	22,000	175,000	-	17,000	-	200 to 900/ surge	26,600	195,000	23,000	-	300,000
Surges	1	2	-	-	-	Numerous	-	Numerous	Numerous	-	-
Watershed Area (km^2)	0.8	3.7	-	-	0.3	-	3.75	0.5	1.37	1.47	44
Geology	Sedimentary, volcanic, till	Metamorphic, till	Metamorphic, volcanic, till	Igneous, talus	Sedimentary, talus	Metamorphic, rockslide debris	Volcanic, intrusive	Sedimentary, metamorphic	Volcanic	-	-
Fan Profile	Concave	-	Concave, lobate	-	Concave, lobate	Concave	-	Lobate	-	-	Concave
Path Length (km)	1.7	3	-	0.8	0.6	3.5	5.1	3.5	1.8	2.4	5.8
El. Difference (m)	660	1400	-	-	250	750	-	600	300	-	-
Avg. (Initiation	45°	25°	-	35°	25°	35°	17°	40°	15° - 30°	-	-
Slope (Mid-Transport	26°	25°	-	28°	15° - 25°	9° - 31°	7°	10°	8°	-	-
(Deposition	6°	8°	13°	7.5°	8°	4° - 6°	5°	4°	4°	-	5°
Recent Deforestation	Yes	No	No	-	-	No	-	Yes	-	-	-
Nature of Debris	Rocks, sand, silt, wood debris and mulch	Rocks, sand, silt	Rocks, sand, clay	Rocks, sand	Rocks, sand, clay	Rocks, sand, silt	Clay to boulders	Rocks, sand, clay	Rocks, sand, silt	-	11 cm avg. dia.
Percent gravel and coarser	-	60 - 70	40	65	-	40	-	70	83	-	-
Water Content (%)	-	13 - 27	-	10	-	17 - 66	-	21	-	-	-
Veloc. (Vel. (m/sec)	1.5	6	-	2.5 - 16	4.5	0.6 - 3.75	-	2.5 - 5	3.8	2 - 3 (est.)	-
Observa- (Depth (m)	1 to 2	1	-	1.5	1.5	0.3 - 1.3	-	1	2	1.5	-
tion (Slope	6°	-	-	15° - 30°	14°	5° - 12°	-	6°	8°	4°	-
Frontal Boulder Accumulation	-	Yes	Yes	Yes	-	Yes	-	Yes	Yes	-	-
Initiation Mechanism	Bank slump (below road)	Bank slumping, channel eros.	Erosion of banks and channel	Rockfall, talus erosion	Debris avalanche channel erosion	Bank slumping, channel erosion	Debris avalanche, channel erosion	Abundant small slumps, channel erosion	Bank and channel erosion	-	Bank and channel erosion
Other Pertinent Observations	Coarse debris deposited at channel exit, liquid debris continued flowing	Caused by a glacial outburst flood	Distinct deposit areas of boulders and liquid fines. Debris includes bentonite	Debris loose and saturated for several days, despite lack of fines	Boulders up to 9000 kg transported	Liquid part of debris flow travelled a further 19 km during 1941 event	Estimated 20 - 40% of debris contributed by channel erosion at rate of 5 m^3/m	Highly erodible sheared shales and sandstones	Point impact forces over 30 kN measured. Occurs 5 times a year	One of four tributaries triggered on the same date	Return period over 100 years

based in part on data from Ishikawa (1982) and Hungr (1981)

Reference: Thurber, 1983

TABLE 4

SUMMARY OF RECORDED EVENTS AND PHYSICAL CHARACTERISTICS OF CREEKS

CREEK		DISBROW	UNNAMED #1	SCLUFIELD	MONTIZAMBERT	STRIP	CHARLES	TURPIN	NEWMAN	LONE TREE	RUNDLE	HARVEY	ALBERTA	MAGNESIA
RECORDED EVENTS	Type:[a]	1 flood; 1 uncertain origin	-	-	-	-	Debris torrents	Debris torrent	3 Debris torrents; 1 flood	-	-	3 floods; 1 uncertain origin	Debris torrents	2 Debris torrents; 1 flood
	Magnitude of debris torrent (m^3):	-	-	-	-	-	10,000 - 20,000	1,500	7,500	-	-	-	450 - 10,000	Not reported
	No. of events in:													
	- last 25 yrs.	1	None	None	None	None	4	1	4	None	None	4	2	3
	- historic record (1906 - 1958)	1	None	None	None	None	None	None	None	None	None	None	None	None
PERTINENT PHYSICAL CHARACTERISTICS OF CREEK	Drainage area(km^2):	1.3	0.4	0.4	4.3	0.3	1.8	0.4	1.8	1.2	0.3	7.0	1.2	4.7
	Recent Fan:													
	- channel gradient	7°-13°(12°av.)	13° av.	17° av.	18° av.	No fan	16° av.	No fan	9°-20°(17°av)	No fan	16° av.	6°-12°(9°av.)	12°-16(14°av.)	5°-12°(10°av.)
	- profile[b]	Concave, lobed	Concave	Uniform	Convex	-	Convex	-	Convex	-	Concave	Concave	Concave, lobed	Concave, lobed
	- material[c]	subang. bldrs	No exposure	No exposure	Rounded bldrs	-	Bldrs	-	Subang. bldrs < 4 m	-	No exposure	Rounded bldrs <2 m	Bldrs <1 m	Subround bldrs <3 m
	- area (m^2)	49800	5100	4500 (?)	10900	-	45100	-	49300	-	1200 (?)	142000	9100	63600
	Elevated fan[d]	No	No	No	Yes	No	No	No	No	Yes	No	Yes	No	No
	Creek length (main channel) (m):	2875	1850	1600	3150	1450	2550	1250	2400	3125	1250	5250	2626	4650
	Including tributary lengths (m):	No trib.	No trib.	No trib.	6176	No trib.	3526	No trib.	3626	No trib.	No trib.	9500	No trib.	10100
	Source elevation (m):	1170	920	730	1080	840	1220	800	1100	1240	440	1300	1220	1440
	Gradient above fan:	14°-44°(32°av.)	31°av.	26°-40°(30°av.)	14°-26°(22°av.)	18°-38° (30° av.)	8°-46°(27°av.)	31°-52°(35°av.)	27°-42°(30°av.)	13°-37° (30° av.)	23° av.	4°-32°(14°av.)	23°-57°(27°av.)	18°-20°(19°av.)
	Creek bank stability (m):													
	- stable	1150 (40%)	740 (40%)	640 (40%)	1550 (25%)	580 (40%)	900 (25%)	375 (30%)	970 (26%)	1250 (40%)	625 (50%)	2950 (31%)	788 (30%)	2565 (25%)
	- potent. unstable	863 (30%)	740 (40%)	640 (40%)	3378 (55%)	435 (30%)	1058 (30%)	375 (30%)	1328 (37%)	1250 (40%)	500 (40%)	3800 (40%)	1050 (40%)	3960 (39%)
	- unstable	863 (30%)	370 (20%)	320 (20%)	1248 (20%)	435 (30%)	1568 (45%)	500 (40%)	1328 (37%)	625 (20%)	125 (10%)	2750 (29%)	788 (30%)	3575 (36%)
	Potential or Active Snow Avalanche Area:	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
	Logging activity (% watershed):	None	None	None	8%	None	1%	25%	16%	None	None	22%	None[e]	32%[e]
	Estimate of maximum available debris(m^3):	36000	12000	10500	84500	9500	63500	6000	36000	38000	7500	180000	31000	135000

Reference: Thurber, 1983

Sheet 1 of 2

TABLE 4 cont'd

CREEK		M CREEK	LOGGERS	DEEKS	BRUNSWICK PT.	BERTRAM	KALLAHNE	UNNAMED #7	UNNAMED #8	FURRY	UNNAMED #9	DAISY	THISTLE	BRITANNIA
RECORDED EVENTS	Type:[a]	Debris torrent	-	Flood	-	-	Floods	-	-	Floods	-	Flood	-	Floods
	Magnitude of debris torrent (m^3):	20,000	-	-	-	-	-	-	-	-	-	-	-	-
	No. of events in: - last 25 yrs. - historic record (1906 - 1958)	1 None	None None	1 None	None None	None None	2 None	None None	None None	2 None	None None	1 None	None None	1 3
PERTINENT PHYSICAL CHARACTERISTICS OF CREEK	Drainage area(km^2):	3.8	2.9	11.6	0.4	1.6	3.6	1.7	1.2	54.3	2.3	2.5	1.6	28.5
	Recent Fan: - channel gradient - profile[b] - material[c] - area (m^2)	6°-10°(8°av.) Concave, lobed Subang. bldrs <2 m 14100	6° av. Convex No exposure 4300	Not determined Concave No exposure 1000 (?)	No fan - - -	No fan - - -	8° av. Concave No exposure 12400	16° av. Concave Sand/gravel 26900(?)	9° av. Concave No exposure 8200	2° av. Concave Rounded bldrs. 379500	No fan - - -	Disturbed Disturbed Sand/gravel Not determined	Disturbed Disturbed Sand/gravel Not determined	3 1/2° (av.) Concave Sand/gravel 154700
	Elevated fan[d]	No	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No
	Creek length (main channel) (m):	3500	3150	4428	950	2800	4700	2500	2225	11250	1525	2925	2250	8425
	Including tributary lengths (m):	6276	4450	No trib.	No trib.	5225	5650	2450	No trib.	25650	4102	4250	2850	14326
	Source elevation (m):	1470	1450	1080	440	1040	1280	1100	550	1070	350	980	610	1110
	Gradient above fan:	23°-32° (28° av.)	21°-35°(27°av)	7°-21°(14°av)	6°-35°(29°av)	9°-31°(21°av)	17°-23°(20°av)	18°-33°(27°av)	8°-36°(14°av)	3°-12°	5°-30°(13°av)	17°-30°(21°av)	19° av.	3°-11° av.
	Creek bank stability (m): - stable - potent. unstable - unstable	1883 (30%) 2510 (40%) 1883 (30%)	1020 (23%) 1965 (44%) 1465 (33%)	2215 (50%) 1328 (30%) 885 (20%)	475 (50%) 285 (30%) 190 (20%)	2090 (40%) 2090 (40%) 1045 (20%)	1790 (32%) 2260 (40%) 1600 (28%)	1725 (50%) 1035 (30%) 690 (20%)	1335 (60%) 445 (20%) 445 (20%)	9945 (39%) 7695 (30%) 8010 (31%)	1640 (40%) 1231 (30%) 1231 (30%)	1700 (40%) 1700 (40%) 850 (20%)	1140 (40%) 1140 (40%) 570 (20%)	5983 (42%) 4298 (30%) 4045 (28%)
	Potential or Active Snow Avalanche Area:	Yes	Yes	Yes, but only above Deeks Lake	No	No	Yes	No	No	Yes	No	No	No	Yes
	Logging activity (% watershed):	38%[e]	41%[e]	11%	5%[f]	None[e]	16%[e]	9%[e]	None	18%[e]	None	None	None	13%[e]
	Estimate of maximum available debris(m^3):	79000	69000	89000	4000	32000	79000	31000	24000	N/A	16500	48000	34000	N/A

Notes:

a) Type of event (debris torrent or flood) as indicated by technical reports and papers and newspaper accounts. One event occurred September 1969 on Harvey Creek is of undetermined type (reports refer to both floods and debris).

b) Refers to characteristics of typical upstream - downstream profile through the recent fan outside of the creek channel.

c) Refers to characteristics indicative of origin of material (debris torrent or fluvial).

d) Elevated fans are separate from the recent fans and are at substantially higher elevations.

e) Forestry road crossing present (1983)

f) Logged, but not adjacent to creek or tributaries.

Reference: Thurber, 1983

CASE RECORDS

- Data Sheets (dBase III)
- Weather Records
- Digitized Profile Records

DATA SHEETS (DBASE III)

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 1
MINE NAME: FCL
DUMP DESIGNATION: BROWNIE E GULLY
LOCATION: EAGLE MOUNTAIN PROJECT

PRE-FAILURE CONDITION

CREST ELEVATION: 2360 M
TOE ELEVATION: 2120 M
DUMP FACE HEIGHT: 240 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 28DEG @TOE
- PROFILE: CONCAVE, TYPE A
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 06/11/83
WEATHER: NOT BELIEVED TO BE A FACTOR
FAILURE TRIGGER: UPPER 30 M BULGING TO 40 DEG, DUMPING STOPPED JUNE 6. STEEP FOUNDATION.
PROPAGATION: "SMALL STURZSTROM"

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: FCL REPORT SHOWS CREST LOCATION
POST - FAILURE: FCL REPORT SHOWS SLIDE OUTLINE
FAILURE VOLUME: 110 CUBIC METRES x 1000
RUN-OUT DISTANCE: 600 M. FROM TOE
RUNOUT SHAPE: CURVED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM ON TILL
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: PART CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: VIRTUALLY ENTIRE DUMP WENT, SCARP WENT 10-12 M BEHIND CREST TO NATIVE GROUND

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGEMENT
GROUND PHOTOS: TOE, SEE FIGURE 1P

SOURCE OF DATA: FCL REPORT JUNE 24, 1983
GOLDER ASSOCIATES REPORT 812-1258

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 3
MINE NAME: FCL
DUMP DESIGNATION: BROWNIE SPOIL D & E GULLY
LOCATION: EAGLE MOUNTAIN

PRE-FAILURE CONDITION

CREST ELEVATION: 2305 M
TOE ELEVATION: 2087 M
DUMP FACE HEIGHT: 218 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 27DEG @TOE
- PROFILE: TYPE A
- MATERIAL: THIN COLLUVIUM ON ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 09/21/84
WEATHER: 88 MM PRECIP IN SEPT.
FAILURE TRIGGER: VERY STEEP TERRAIN

PROPAGATION: DISTAL PORTION SPREAD

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: FCL REPORT SHOWS CREST
POST - FAILURE: FCL REPORT SHOWS SLIDE LIMITS
FAILURE VOLUME: 500 CUBIC METRES x 1000
RUN-OUT DISTANCE: 640 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM
SPECIAL FEATURES: PREVIOUS SLIDE
TYPICAL TRANSVERSE SECTION: PARTLY CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: NOTE PREVIOUS FAILURE IN (E) GULLY IN JUNE 83

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGED AVAILABLE
GROUND PHOTOS: REFER TO FIGURE 1P

SOURCE OF DATA: FCL INTERNAL REPORT

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 5
MINE NAME: FCL
DUMP DESIGNATION: BROWNIE GULLY F
LOCATION: EAGLE MOUNTAIN PROJECT

PRE-FAILURE CONDITION

CREST ELEVATION: 2315 M
TOE ELEVATION: 2105 M
DUMP FACE HEIGHT: 210 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 28 DEG
- PROFILE: A/B
- MATERIAL: TILL
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 07/24/84
WEATHER:
FAILURE TRIGGER: GROUNDWATER PREVIOUSLY SEEN IN TOE REGION

PROPAGATION: FAILURE DID NOT REACH CREST

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: REF FCL REPORT
POST - FAILURE: REF FCL REPORT
FAILURE VOLUME: 300 CUBIC METRES x 1000
RUN-OUT DISTANCE: 780 M. FROM TOE
RUNOUT SHAPE: N/A
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: NO DUMPING IN 10 DAYS PRIOR. NOTE THAT FILE 3 SHOWS F GULLY SLIDE TOE. HAS REACHED MAIN CREEK.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGED, REFER TO FIGURE 1P
GROUND PHOTOS:

SOURCE OF DATA: FCL INTERNAL REPORT (NOT DATED)
GA 812-1258

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 6
MINE NAME: FCL
DUMP DESIGNATION: BROWNIE "B"
LOCATION: EAGLE MOUNTAIN PROJECT

PRE-FAILURE CONDITION

CREST ELEVATION: 2280 M
TOE ELEVATION: 2085 M
DUMP FACE HEIGHT: 195 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 24 DEG
- PROFILE: TYPE A
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 08/16/85
WEATHER: 50 MM RAIN PRIOR 2 WEEKS
FAILURE TRIGGER: UPPER SLOPES VERY STEEP. SPOILING STOPPED AUG. 15. CREST OVERSTEEP AND TOE BULGING.
PROPAGATION: GRADUAL. TOE CREPT ALONG CREEK.

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE:
POST - FAILURE:
FAILURE VOLUME: 140 CUBIC METRES x 1000
RUN-OUT DISTANCE: 610 M. FROM TOE
RUNOUT SHAPE: LINEAR/SEE COMMENT
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: PART CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: MOST OF SPOIL DERIVED FROM ADJACENT SPOIL (A) TO NORTH SINCE TOO STEEP TO INITIATE IN GULLY (B) ITSELF. ADVANCED 800 M INITIALLY, THEN ADVANCED FURTHER 150 M DOWN CREEK.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGEMENT AVAILABLE
GROUND PHOTOS:

SOURCE OF DATA: FCL REPORT SEPT. 25, 1985

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 7
MINE NAME: FCL
DUMP DESIGNATION: "G" SPOIL
LOCATION: EAGLE MOUNTAIN PROJECT

PRE-FAILURE CONDITION

CREST ELEVATION: 2380 M
TOE ELEVATION: 2100 M
DUMP FACE HEIGHT: 280 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 27 DEG
- PROFILE: TYPE A
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 06/29/85
WEATHER: NOT A FACTOR
FAILURE TRIGGER: TOE RELEASE, FOLLOWING PROMINENT BULGE IN PRECEEDING 2 WEEKS.

PROPAGATION: FAILURE DEBRIS DID NOT RUN OUT ONTO SLIDE DEBRIS FROM ADJACENT GULLY (F)

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE:
POST - FAILURE:
FAILURE VOLUME: 50 CUBIC METRES x 1000
RUN-OUT DISTANCE: 310 M. FROM TOE
RUNOUT SHAPE: PATH NOT DEFINED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM ON TILL
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: PART CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: CROSS SECTION LOCATION AND POSITION OF CREST AND TOE ARE ESTIMATES SINCE NO DATA AVAILABLE. DUMPING TERMINATED JUNE 27.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGED AVAILABLE

GROUND PHOTOS:

SOURCE OF DATA: FORDING LETTER TO MINE INSPECTOR

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 11
MINE NAME: FCL
DUMP DESIGNATION: BROWNIE BETWEEN G & H GULLIES
LOCATION: EAGLE MOUNTAIN

PRE-FAILURE CONDITION

CREST ELEVATION: 2270 M
TOE ELEVATION: 2010 M
DUMP FACE HEIGHT: 260 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 25 DEG
- PROFILE: TYPE A
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 09/16/85
WEATHER: 36 MM OF RAIN WITHIN 6 DAYS
FAILURE TRIGGER: VERY STEEP TERRAIN. PROMINENT BULGE PRECEEDING WEEK.

PROPAGATION: SUSPECT SLOW

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:4000
PRE - FAILURE: N/A
POST - FAILURE: N/A
FAILURE VOLUME: 225 CUBIC METRES x 1000
RUN-OUT DISTANCE: 560 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM
SPECIAL FEATURES: PRE-EXISTING SLIDE DEBRIS
TYPICAL TRANSVERSE SECTION: UNCONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: NOTE THAT DEBRIS SLIDE OVER TOP OF PRE-EXISTING SLIDE DEBRIS. SUSPECT THAT FAILURE GRADUAL. NOT RAPID.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGEMENT AVAILABLE
GROUND PHOTOS:

SOURCE OF DATA: FC LETTER TO INSPECTOR OF MINES (OCT 8/85). SEE JUN 11/83 FILE FOR ORIGINAL TOPOGRAPHY (BEST). ALSO SEE GEN BROWNIE FILE.

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 12
MINE NAME: FCL
DUMP DESIGNATION: 13 SEAM ALTERNATE SPOIL
LOCATION: EAGLE MOUNTAIN, ELKFORD, B.C.

PRE-FAILURE CONDITION

CREST ELEVATION: 2330 M
TOE ELEVATION: 2150 M
DUMP FACE HEIGHT: 180 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 25-45 DEG
- PROFILE: B/A
- MATERIAL: COLLUVIUM
PRECEDING ACTIVITY: NONE

FAILURE DATA

DATE: 08/14/86
WEATHER: NO MAJOR PRECIPITATION REPORTED
FAILURE TRIGGER: THAWING OF TRAPPED SNOW/ICE LAYERS, EXIT REPORTED ABOVE TOE OF DUMP FACE BULGING IN PRECEEDING MONTH VERY STEEP TOPOGRAPHY
PROPAGATION: APPARENTLY NOT A VERY HIGH VELOCITY EVENT - DURATION OF ABOUT 30 MINUTES

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: ESTIMATED PROFILE
POST - FAILURE: 1990 PICK UP AT 1:5000
FAILURE VOLUME: 250 CUBIC METRES x 1000
RUN-OUT DISTANCE: 210 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM ROCK & WASTE ROCK
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: UNCONFINED
NATURE OF RUNOUT DEBRIS: VARIABLE, USED AS EMERG. CHIMP
VELOCITY ESTIMATE:

COMMENTS: DUMP INACTIVE FOR 2.5 MONTHS. DUMP FOUNDATION SLOPE IN RANGE 25 - 45 DEGREES I.E., VERY STEEP.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGEMENT AVAILABLE
GROUND PHOTOS:

SOURCE OF DATA: FCL LETTER TO MEMPR, SEPT 2/86

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 14
MINE NAME: FCL
DUMP DESIGNATION: BLACKSTONE EMERGENCY DUMP
LOCATION: EAGLE MOUNTAIN

PRE-FAILURE CONDITION

CREST ELEVATION: 2240 M
TOE ELEVATION: 2030 M
DUMP FACE HEIGHT: 210 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 29 DEG
- PROFILE: A
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: NONE ? BLASTING

FAILURE DATA

DATE: 10/05/86
WEATHER: CLEAR, SUNNY AT EVENT TIMES
FAILURE TRIGGER: STEEP TOPOGRAPHY

PROPAGATION:

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: N/A
POST - FAILURE: 1:5000 (1990)
FAILURE VOLUME: 115 CUBIC METRES x 1000
RUN-OUT DISTANCE: 750 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: NOTE THAT 1990 SURVEY SHOWS MOUND OF DEBRIS IN CREEK DOWNSTREAM IS 20 M THICK. INACTIVE FOR 4 MONTHS.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHO ENLARGEMENT, REFER FIGURE 14P
GROUND PHOTOS:

SOURCE OF DATA: FCL REPORT TO INSPECTOR OF MINES

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 16
MINE NAME: FCL
DUMP DESIGNATION: BLACKPILL SPOIL
LOCATION: EAGLE MOUNTAIN

PRE-FAILURE CONDITION

CREST ELEVATION: 2270 M
TOE ELEVATION: 2130 M
DUMP FACE HEIGHT: 140 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 33 DEG
- PROFILE: CONVEX, B
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: NONE

FAILURE DATA

DATE: 07/17/85
WEATHER: 05/27-06/07: 49 MM; 06/12-06/14: 5.5 MM
FAILURE TRIGGER: TOE RELEASE ON STEEP FOUNDATION - NO SPOILING AFTER MAY 16/85

PROPAGATION: STURZSTROM. ACTUAL RUNOUT PATH MAY HAVE RIDDEN UP ON SIDE OF GULLY, WELL UPSTREAM

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: N/A
POST - FAILURE: REFER TO 1990 SPOIL THICKNESS MAP
FAILURE VOLUME: 55 CUBIC METRES x 1000
RUN-OUT DISTANCE: 880 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM, SATURATED
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: ESTIMATED 10,000 LCM TRAVELLED INTO MAIN CHANNEL. REMAINDER DID NOT MOVE FAR PERHAPS THERE WERE SEVERAL SUB-EVENTS

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ENLARGED ORTHOSHOT, REFER FIGURE 16P
GROUND PHOTOS: REFER FIGURE 16P

SOURCE OF DATA: FCL INTERNAL REPORT: JULY 4/85

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 19
MINE NAME: FCL
DUMP DESIGNATION: CLODE SPOIL PILES
LOCATION: EAGLE MOUNTAIN, ELKFORD, B.C.

PRE-FAILURE CONDITION

CREST ELEVATION: 6450 FT
TOE ELEVATION: 6000 FT
DUMP FACE HEIGHT: 450 FT
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 25 DEG
- PROFILE: TYPE A
- MATERIAL: LAB TXL & BACK ANALYSIS, COLLUVIUM

PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 05/05/72
WEATHER: RELATIVELY DRY, BUT HEAVY SNOWFALL
FAILURE TRIGGER: OVERLOADING STEEP UPPER REACH OF FOUNDATION

PROPAGATION: NOT RAPID

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: SEE FILE
POST - FAILURE:
FAILURE VOLUME: 55 CUBIC METRES x 1000
RUN-OUT DISTANCE: 460 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM ON TILL
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: UNCONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: WATER PRESSURE NOT CONSIDERED TO BE A FACTOR. BACK ANALYSIS AGREES WITH LAB TEST DATA.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: 1972 ORTHOSHOT ENLARGEMENT AVAILABLE

GROUND PHOTOS: FROM GOLDER ASSOCIATES V72112 REPORT

SOURCE OF DATA: GOLDER ASSOCIATES: V-72112

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 20
MINE NAME: FCL
DUMP DESIGNATION: CLODE SPOIL PILES
LOCATION: EAGLE MOUNTAIN, ELKFORD, B.C.

PRE-FAILURE CONDITION

CREST ELEVATION: 6450 FT
TOE ELEVATION: 6000 FT
DUMP FACE HEIGHT: 450 FT
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 25 DEG
- PROFILE: TYPE B
- MATERIAL: COLLUVIUM ON ROCK, OCT/71 REPORT, BACK ANALYSIS CONFRM

PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 05/27/72
WEATHER: RELATIVELY DRY, HEAVY SNOW
FAILURE TRIGGER: OVERLOADING STEEP UPPER PORTION OF SLOPE, NORMAL SHEAR FAILURE

PROPAGATION: FAILURE PROCEEDED ALONG 15 DEG SLOPE & OVER A HORIZONTAL BERM 215' WIDE ? STURZSTROM

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL:
PRE - FAILURE: FILE V-72112 FIGURE 4
POST - FAILURE:
FAILURE VOLUME: 150 CUBIC METRES x 1000
RUN-OUT DISTANCE: 480 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM
SPECIAL FEATURES: OVER-RODE BERM
TYPICAL TRANSVERSE SECTION: UNCONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: BACK ANALYSIS CONFIRMED FOUNDATION SHEAR STRENGTH ASSESSED FROM TRIAXIAL TESTING

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGEMENT AVAILABLE

GROUND PHOTOS: REFER REPORT

SOURCE OF DATA: GOLDER ASSOCIATES: V-72112

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 24
MINE NAME: FCL
DUMP DESIGNATION: CLODE WASTE PILE
LOCATION: EAGLE MOUNTAIN, ELKFORD, B.C.

PRE-FAILURE CONDITION

CREST ELEVATION: 6367 FT
TOE ELEVATION: 5650 FT
DUMP FACE HEIGHT: 717 FT
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 25-30 DEG
- PROFILE: TYPE B
- MATERIAL: COLLUVIUM CONFIRMED EARLIER SEE '72 FAILURE
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 11/08/74
WEATHER:
FAILURE TRIGGER: OVERLOADING OF STEEP FOUNDATION, NORMAL SHEAR ON FOUNDATION

PROPAGATION: RAPID FAILURE, BUCKLED TREES INTERCEPTED LYING POINTING UPHILL

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: N/A
POST - FAILURE: N/A
FAILURE VOLUME: N.A.
RUN-OUT DISTANCE: 550 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL:
SPECIAL FEATURES: FLAT RUNOUT
TYPICAL TRANSVERSE SECTION: UNCONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: DUMPING STOPPED 7 HRS PRIOR TO FAILURE SIMILAR TO EVENTS 19, 20

AIR PHOTOS - NUMBERS: N/A
- REMARKS: N/A
GROUND PHOTOS: REFER REPORT

SOURCE OF DATA: GOLDER ASSOCIATES: V-74118

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 27
MINE NAME: FCL
DUMP DESIGNATION: CLODE WASTE PILE
LOCATION: EAGLE MOUNTAIN, ELKFORD, B.C.

PRE-FAILURE CONDITION

CREST ELEVATION: 1947 M
TOE ELEVATION: 1837 M
DUMP FACE HEIGHT: 110 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 20 DEG
- PROFILE: TYPE A
- MATERIAL: NATIVE ORGANIC, WEAK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 11/12/74
WEATHER:
FAILURE TRIGGER: YIELDING OF NATIVE ORGANIC SOIL DESCRIBED AS A SLUMP. CREST DROPPED 100 M IN 3 HOURS
PROPAGATION: MUD FLOW? LARGE VOLUME OF ORGANIC SOIL DISPLACED AHEAD OF DUMP

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: SEE SKETCH PROFILE
POST - FAILURE: SEE SKETCH PROFILE
FAILURE VOLUME: 750 CUBIC METRES x 1000
RUN-OUT DISTANCE: 220 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: WET, ORGANIC
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: UNCONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: GRADUAL FAILURE

AIR PHOTOS - NUMBERS:
- REMARKS: N/A

GROUND PHOTOS: REFER REPORT

SOURCE OF DATA: GOLDER ASSOCIATES: V-74118

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 35
MINE NAME: WESTAR BALMER
DUMP DESIGNATION: BRIDGE 3 DUMP
LOCATION: HARMER II

PRE-FAILURE CONDITION

CREST ELEVATION: 6120 FT
TOE ELEVATION: 5400 FT
DUMP FACE HEIGHT: 720 FT
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 35 DEG
- PROFILE: B/C
- MATERIAL:
PRECEDING ACTIVITY: INACTIVE

FAILURE DATA

DATE: 11/18/80
WEATHER: ATTACHED
FAILURE TRIGGER: STEEP TOE FOUNDATION

PROPAGATION: CREEPING SLUMP

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: FEBRUARY 1965
PRE - FAILURE: N/A
POST - FAILURE: N/A
FAILURE VOLUME: N.A.
RUN-OUT DISTANCE: 160 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: SLIDE DEBRIS
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: UNCONFIRMED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS:

AIR PHOTOS - NUMBERS: NO
- REMARKS:
GROUND PHOTOS: YES

SOURCE OF DATA: GOLDER ASSOCIATES AND WESTAR FILES

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 36
MINE NAME: WESTAR BALMER
DUMP DESIGNATION: C1 DUMP
LOCATION: ADIT 40

PRE-FAILURE CONDITION

CREST ELEVATION: 1823 M
TOE ELEVATION: 1673 M
DUMP FACE HEIGHT: 150 M
QUALITY OF WASTE: ? POOR QUALITY, ? SNOW
FOUNDATION - TOE SLOPE: 25DEG @TOE
- PROFILE: TYPE B
- MATERIAL: COLLUVIUM ON ROCK

PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 06/29/82
WEATHER: JUNE 1982 RECORD
FAILURE TRIGGER: STEEP TOE, ? PRECIPITATION

PROPAGATION: RAPID, WITH MAJOR SUPER ELEVATION OF DEBRIS WHEN DEFLECTED BY VALLEY SIDE

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: ATTACHED
PRE - FAILURE: 1980 (1 INCH = 200 FT)
POST - FAILURE: 1984 (DISTAL REGION)
FAILURE VOLUME: 650 CUBIC METRES x 1000
RUN-OUT DISTANCE: 1140 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM/ALLUVIUM
SPECIAL FEATURES: SUPER ELEVATION
TYPICAL TRANSVERSE SECTION: PARTLY CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE: SEE BELOW

COMMENTS: VELOCITY CALCULATED BY WESTAR = 20 M/S ON CURVE. ONLY 150,000 M3 REACHED DISTAL REGION SO REMAINING 600,000 M3 DEPOSITED IN RUNOUT PATH

AIR PHOTOS - NUMBERS:
- REMARKS: FROM HELICOPTER

GROUND PHOTOS: AVAILABLE

SOURCE OF DATA: GOLDER ASSOCIATES FILE

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 38
MINE NAME: WESTAR BALMER
DUMP DESIGNATION: SOUTH DUMP
LOCATION: ADIT 29

PRE-FAILURE CONDITION

CREST ELEVATION: 5975 FT
TOE ELEVATION: 0 FT
DUMP FACE HEIGHT: 5975 FT
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 26 DEG
- PROFILE: B
- MATERIAL: COLLUVIUM/TILL/ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 02/08/76
WEATHER: COLD
FAILURE TRIGGER: STEEP TYPE B FOUNDATION

PROPAGATION: RAPID

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: FEBRUARY 1965
PRE - FAILURE:
POST - FAILURE:
FAILURE VOLUME: N.A.
RUN-OUT DISTANCE: 550 M. FROM TOE
RUNOUT SHAPE: DEFL.
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM/TILL/ROCK
SPECIAL FEATURES: SHARP TURN
TYPICAL TRANSVERSE SECTION: PART CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS:

AIR PHOTOS - NUMBERS: YES
- REMARKS: AVAILABLE POST FAILURE
GROUND PHOTOS: REFER FIGURE 38P

SOURCE OF DATA: GOLDER ASSOCIATES REPORT #77087

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 40

MINE NAME: WESTAR BALMER

DUMP DESIGNATION: NO. 2

LOCATION: BALMER PIT

PRE-FAILURE CONDITION

CREST ELEVATION: 4770 FT

TOE ELEVATION: 4200 FT

DUMP FACE HEIGHT: 570 FT

QUALITY OF WASTE:

FOUNDATION - TOE SLOPE: 32 DEG

- PROFILE: A

- MATERIAL: GLACIAL SANDS, GRAVELS, ? LACUST. CLAY

PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 11/23/68

WEATHER: HEAVY RAIN

FAILURE TRIGGER: SATURATED STEEPLY DIPPING TOE FOUNDATION RELEASE

PROPAGATION: RAPID

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: NO

PRE - FAILURE: ESTIMATED

POST - FAILURE: 1 IN/200 FT.

FAILURE VOLUME: 150 CUBIC METRES x 1000

RUN-OUT DISTANCE: 620 M. FROM TOE

RUNOUT SHAPE: CURVED

RUNOUT PATH SURFICIAL SOIL: COLLUVIUM/TILL

SPECIAL FEATURES:

TYPICAL TRANSVERSE SECTION: UNCONFINED

NATURE OF RUNOUT DEBRIS:

VELOCITY ESTIMATE:

COMMENTS: FAILURE MAY HAVE BEEN INFLUENCED BY WEAK LACUSTRIAN SOILS, AND FOUNDATION SEEPAGE.

AIR PHOTOS - NUMBERS: YES

- REMARKS: REFER FIGURE 40P

GROUND PHOTOS: REFER FIGURE 40P

SOURCE OF DATA: GOLDER ASSOCIATES REPORT V6880, SECTION FROM 77151

COMPILED BY: A. KENT

DATE: 08/30/91

UPDATED BY:

DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 42

MINE NAME: WESTAR BALMER

DUMP DESIGNATION: NORTH WASTE DUMP

LOCATION: ADIT 29

PRE-FAILURE CONDITION

CREST ELEVATION: 6770 FT

TOE ELEVATION: 5920 FT

DUMP FACE HEIGHT: 850 FT

QUALITY OF WASTE:

FOUNDATION - TOE SLOPE: 27 DEG

- PROFILE: A CONCAVE

- MATERIAL: TILLS

PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 05/05/71

WEATHER:

FAILURE TRIGGER: RECENTLY STARTED DUMPS ON STEEP FOUNDATION, SPRING MELT, LOTS OF BURIED SNOW. FOUNDATION P.W.P.

PROPAGATION: RAPID

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: FEBRUARY 1965

PRE - FAILURE: N/A

POST - FAILURE: AVAILABLE

FAILURE VOLUME: 2200 CUBIC METRES x 1000

RUN-OUT DISTANCE: 2600 M. FROM TOE

RUNOUT SHAPE: DEFL.

RUNOUT PATH SURFICIAL SOIL: COLLUVIUM/ORGANICS

SPECIAL FEATURES:

TYPICAL TRANSVERSE SECTION: CONFINED

NATURE OF RUNOUT DEBRIS:

VELOCITY ESTIMATE:

COMMENTS: RELATIVELY SMALL VOLUME RAN OUT

AIR PHOTOS - NUMBERS: FFL: FF8049-L5-90

- REMARKS: REFER FIGURE 42P

GROUND PHOTOS: REFER FIGURE 42P

SOURCE OF DATA: GOLDER AASSOCIATES REPORT V77151

COMPILED BY: A. KENT

DATE: 08/30/91

UPDATED BY:

DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 43
MINE NAME: KAISER RESOURCES
DUMP DESIGNATION: HARMER KNOB
LOCATION: SIX MILE CREEK

PRE-FAILURE CONDITION

CREST ELEVATION: 6600 FT
TOE ELEVATION: 6200 FT
DUMP FACE HEIGHT: 400 FT
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 21 DEG
- PROFILE: A
- MATERIAL: COLLUVIUM/ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 05/31/71
WEATHER: SPRING RUNOFF, WET.
FAILURE TRIGGER: STEEP FOUNDATION, POSSIBLE WATER PRESSURE. CREEP/SLUMP INITIALLY.

PROPAGATION: "MUD FLOW" DOWN PRE-EXISTING CHANNEL.

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: FEBRUARY 1965 AVAILABLE
PRE - FAILURE:
POST - FAILURE: APRIL 1978
FAILURE VOLUME: N.A.
RUN-OUT DISTANCE: 3200 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM/TILL/ROCK
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: EXPOSED DEBRIS IN RUNOUT CHANNEL IS WASTE ROCK.

AIR PHOTOS - NUMBERS: FLL 8049-L3-43
- REMARKS:

GROUND PHOTOS: AVAILABLE

SOURCE OF DATA: GOLDER ASSOCIATES V77151

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 44
MINE NAME: WESTAR-BALMER
DUMP DESIGNATION: 6380 EL
LOCATION: ADIT 29S

PRE-FAILURE CONDITION

CREST ELEVATION: 6380 FT
TOE ELEVATION: 6056 FT
DUMP FACE HEIGHT: 324 FT
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 35 DEG
- PROFILE: C
- MATERIAL:
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 05/23/73
WEATHER: THAWING
FAILURE TRIGGER: SPRING THAW

PROPAGATION: RAPID

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: FEBRUARY 1965
PRE - FAILURE:
POST - FAILURE: JULY 1973
FAILURE VOLUME: 110 CUBIC METRES x 1000
RUN-OUT DISTANCE: 2500 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM ON TILL/ROCK
SPECIAL FEATURES: ORGANICS
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: UNUSUALLY LONG RUNOUT DUE ORGANICS.

AIR PHOTOS - NUMBERS: FFL 8049-L6-112
- REMARKS: POST FAILURE
GROUND PHOTOS: YES

SOURCE OF DATA: GOLDER ASSOCIATES V77151, KAISER FILE MEMO

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 48
MINE NAME: QUINTETTE
DUMP DESIGNATION: 1640 DUMP
LOCATION: MESA MIDDLE

PRE-FAILURE CONDITION

CREST ELEVATION: 1640 M
TOE ELEVATION: 1440 M
DUMP FACE HEIGHT: 200 M
QUALITY OF WASTE: MODERATE
FOUNDATION - TOE SLOPE: 17 DEG
- PROFILE: A/B
- MATERIAL: COLLUVIUM/ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 06/21/86
WEATHER: NO RAIN PRECEEDING 4 DAYS; 35MM JUNE 15
FAILURE TRIGGER: HIGH LOADING RATES. DISTINCT TOE BULDGE.
HIGH RATE CREST DISPL. OVER PRIOR 3 MONTHS.
PROPAGATION: DID NOT APPEAR TO HAVE FAILED WITH HIGH VELOCITY

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE: CONTOUR MAPS & OUTLINE WRT TO 1705 FAIL
POST - FAILURE: CONTOUR MAPS & OUTLINE WRT TO 1705 FAIL
FAILURE VOLUME: 600 CUBIC METRES x 1000
RUN-OUT DISTANCE: 400 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: PREVIOUS SLIP
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: PART CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: NO SIGN PREVIOUS FAILURE SINCE OPENING APR/85. LAND PHOTO MAY SUGGEST SIGNIFICANT PRESENCE OF CARBONACEOUS FINES

AIR PHOTOS - NUMBERS:
- REMARKS:
GROUND PHOTOS: YES

SOURCE OF DATA: QCL INTERNAL REPORT POST FAILURE CONTOURS WITH JUN 30/86 FILE (ATT) REPORT TO MINISTRY OF MINES

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 49
MINE NAME: QUINTETTE
DUMP DESIGNATION: 1705 DUMP
LOCATION: WOLVERINE NORTH

PRE-FAILURE CONDITION

CREST ELEVATION: 1705 M
TOE ELEVATION: 1495 M
DUMP FACE HEIGHT: 210 M
QUALITY OF WASTE: GOOD
FOUNDATION - TOE SLOPE: 28 DEG
- PROFILE: B A B
- MATERIAL: COLLUVIUM, PREVIOUS SLIDE DEBRIS
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 06/30/86
WEATHER: DRY IN PRECEEDING WEEK
FAILURE TRIGGER: DUMPING STOPPED 2 DAYS PRIOR TO MOVEMENT RATE INCREASE ?MINE RUNOFF

PROPAGATION: TRAVELED AT 70-90KPH, FLOWED LIKE WATER PROPAGATED FROM TOE TO CREST, DUMP TOE "EXPLODED"

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE: CREST, TOE ESTIMATED
POST - FAILURE: 1:5000
FAILURE VOLUME: 1600 CUBIC METRES x 1000
RUN-OUT DISTANCE: 1700 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: SLIDE DEBRIS
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS: MOSTLY SANDSTONE & CONGLOMERAT
VELOCITY ESTIMATE: 70 - 90

COMMENTS: DUMP STARTED JUL/84. PREVIOUS SLIDES ON JUN 17, OCT 16, NOV 10/85

AIR PHOTOS - NUMBERS:
- REMARKS:
GROUND PHOTOS:

SOURCE OF DATA: QCL 2ND QUARTER 1986 REPORT. REPORT TO MINISTRY OF MINES JUL 10/86

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 54
MINE NAME: QUINTETTE
DUMP DESIGNATION: 1660 N DUMP
LOCATION: MARMOT

PRE-FAILURE CONDITION

CREST ELEVATION: 1660 M
TOE ELEVATION: 1420 M
DUMP FACE HEIGHT: 240 M
QUALITY OF WASTE: WET FINES PRESENT
FOUNDATION - TOE SLOPE: 18-20 DEG
- PROFILE: A CONCAVE
- MATERIAL: THIN COLLUVIUM ON ROCK
PRECEDING ACTIVITY: INACTIVE

FAILURE DATA

DATE: 09/09/85
WEATHER: 25MM RAIN PRECEEDING WEEK & SOME SNOW
FAILURE TRIGGER: SEEPAGE IN TOE REGION, (1982 OBSERVATION) TOGETHER WITH FINE GRAINED ROCK. DUMP ITSELF NOT ACTIVE BUT ADJACENT DUMPS ACTIVE.
PROPAGATION: "MUD FLOW" OF WET FINE GRAINED WASTE

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE: N/A
POST - FAILURE: 1:5000 BASED ON SEP 10/85 FLIGHT
FAILURE VOLUME: 2500 CUBIC METRES x 1000
RUN-OUT DISTANCE: 2200 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM/TILL OR BEDROCK
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: MAY BE FEASIBLE TO CALCULATE VELOCITY AT DEFLECTION POINT.

AIR PHOTOS - NUMBERS: G.A.S.L. 8806025-3-95
- REMARKS:
GROUND PHOTOS: AVAILABLE (SEP/87)

SOURCE OF DATA: PITEAU FILE 923-15, REPORT OCT 28/85

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 62
MINE NAME: LINE CREEK MINE
DUMP DESIGNATION: 1996 DUMP
LOCATION: WEST LINE CREEK

PRE-FAILURE CONDITION

CREST ELEVATION: 1966 M
TOE ELEVATION: 1830 M
DUMP FACE HEIGHT: 136 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 34 DEG
- PROFILE: A B
- MATERIAL: COLLUVIUM, SATURATED IN VALLEY BASE
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 07/01/82
WEATHER: SEVERAL DAYS HEAVY RAIN (4MM/DAY/5 DAYS)
FAILURE TRIGGER: STEEP TOPOGRAPHY

PROPAGATION: FLUIDIZATION OF SAT FD'N SOIL. NOT STURZSTROM. MOST OR ALL SCOURED OUT. APPROX. HALF SLIDE MASS RAN OUT, REST STAYED AT BASE OF SLOPE.

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:400
PRE - FAILURE: GA REPORT 812-1052B FIGURE 2 (1:5000)
POST - FAILURE: 1:5000 AUG/82
FAILURE VOLUME: 2500 CUBIC METRES x 1000
RUN-OUT DISTANCE: 2100 M. FROM TOE
RUNOUT SHAPE: MAJOR DEFLECTION
RUNOUT PATH SURFICIAL SOIL: SATURATED, COLLUVIUM
SPECIAL FEATURES: LIQUEFIED
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS: COMPETENT, COARSE
VELOCITY ESTIMATE:

COMMENTS: A THOROUGHLY INVESTIGATED EVENT, NOT CONSIDERED TO BE STURZSTROM SINCE TRAVEL SIGNIFICANTLY GREATER THAN OTHER STURZSTROMS.

AIR PHOTOS - NUMBERS: GOLDER ASSOCIATES 812-1052B FIGURE 4
- REMARKS:
GROUND PHOTOS: GOLDER ASSOCIATES 812-1052B

SOURCE OF DATA: 832-1015, VOL. EST.
812-1052B

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 75
MINE NAME: WESTAR
DUMP DESIGNATION: HAWK PIT DUMP
LOCATION: GREENHILLS

PRE-FAILURE CONDITION

CREST ELEVATION: 2158 M
TOE ELEVATION: 2000 M
DUMP FACE HEIGHT: 158 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 27.5 DEG
- PROFILE: A
- MATERIAL: COLLUVIUM WITH 0.6 M OF SNOW
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 03/20/83
WEATHER: DRY, RIVER LEVELS LOW, COLD
FAILURE TRIGGER: STEEP FOUNDATION, POOR WASTE ROCK QUALITY, AGGRAVATED BY SNOW? OVERSTEEPENED FACE NEAR CREST
PROPAGATION: STURZSTOM

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000 (COMPUTER RE-DRAWN FROM NATURAL)
PRE - FAILURE: OUTLINE ONLY
POST - FAILURE: OUTLINE ONLY
FAILURE VOLUME: 360 CUBIC METRES x 1000
RUN-OUT DISTANCE: 850 M. FROM TOE
RUNOUT SHAPE: SLIGHT DEFLECTION
RUNOUT PATH SURFICIAL SOIL: FROZEN COLLUVIUM
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: PARTLY CONFINED
NATURE OF RUNOUT DEBRIS: POOR, WEATHERED
VELOCITY ESTIMATE: MAYBE FROM RUNUP

COMMENTS: DUMP INACTIVE 8 DAYS PRECEEDING FAILURE. CALCULATION OF VELOCITY FROM RUN UP OPPOSITE. VALLEY SLOPE.

AIR PHOTOS - NUMBERS: G.A.S.L. WP9015-2-23
- REMARKS:
GROUND PHOTOS: AVAILABLE

SOURCE OF DATA: WESTAR GREENHILLS MEMO MAR 29/83 BY D. PARSONS. VELOCITY CALC'S ATTEMPTED

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 76
MINE NAME: WESTAR
DUMP DESIGNATION: 2200 EAST DUMP
LOCATION: GREENHILLS

PRE-FAILURE CONDITION

CREST ELEVATION: 2207 M
TOE ELEVATION: 2039 M
DUMP FACE HEIGHT: 168 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 14
- PROFILE: CONCAVE
- MATERIAL: COLLUVIUM
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 05/11/83
WEATHER: FRESHET BEGUN BUT NOT AT PEAK
FAILURE TRIGGER: EXCESS P.W.P. IN COLLUVIUM. BACK ANALYSIS DUMPING IN PROGRESS AT TIME FAILED. QUASI-CIRCULAR SLUMP.
PROPAGATION: NOT CONSIDERED TO BE STURZSTROM

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2500 (WESTAR DWG. 301, MAY/83)
PRE - FAILURE: SHOWN ON ABOVE DWG.
POST - FAILURE: REFER TO PROFILE ON FIGURE 3
FAILURE VOLUME: 700 CUBIC METRES x 1000
RUN-OUT DISTANCE: 380 M. FROM TOE
RUNOUT SHAPE: MOSTLY LINEAR
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM ON ROCK
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: P.C.
NATURE OF RUNOUT DEBRIS: PROBABLY RELATIVELY POOR
VELOCITY ESTIMATE:

COMMENTS: WESTAR BACK ANALYSIS INFERS EXCESS PORE PRESSURE AS CAUSE OF FAILURE

AIR PHOTOS - NUMBERS: G.A.S.L. WP9015-2-23
- REMARKS:
GROUND PHOTOS:

SOURCE OF DATA: WESTAR INTERNAL REPORT MAY/83, REF. 2.11 #27

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 79
MINE NAME: WESTAR
DUMP DESIGNATION: EAST WASTE DUMP (2540 DUMP)
LOCATION: GREENHILLS

PRE-FAILURE CONDITION

CREST ELEVATION: 2145 M
TOE ELEVATION: 1985 M
DUMP FACE HEIGHT: 160 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 18 DEG
- PROFILE: TYPE A
- MATERIAL: THIN COLLUVIUM ON BEDROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 07/12/86
WEATHER: WARM, 12MM IN PAST WEEK, 32MM IN 2 WKS
FAILURE TRIGGER: FOUNDATION SEEPAGE, POOR QUALITY SPOIL STEEP TOPOGRAPHY

PROPAGATION: RAPID

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE:
POST - FAILURE: 1:2500 (ORIGINAL TOPO)
FAILURE VOLUME: 480 CUBIC METRES x 1000
RUN-OUT DISTANCE: 530 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: SLIDE DEBRIS
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: P.C.
NATURE OF RUNOUT DEBRIS: POOR
VELOCITY ESTIMATE:

COMMENTS: MOST OF RUNOUT OVER TOP OF PREVIOUS SLIDE DEBRIS FROM MAY 30/85 SLIDE

AIR PHOTOS - NUMBERS: G.A.S.L. WP9015-2-23
- REMARKS: REFER FIGURE 75P
GROUND PHOTOS: N/A

SOURCE OF DATA: GOLDER FILE 862-1409
GOLDER FILE 792-1120, 1120B

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 80
MINE NAME: WESTAR
DUMP DESIGNATION: EAST WASTE DUMP (2140 DUMP)
LOCATION: GREENHILLS

PRE-FAILURE CONDITION

CREST ELEVATION: 2144 M
TOE ELEVATION: 2025 M
DUMP FACE HEIGHT: 119 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 35
- PROFILE: B
- MATERIAL: FROZEN COLLUVIUM ON ROCK?

PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 02/12/87
WEATHER:
FAILURE TRIGGER: POOR QUALITY ROCK. FOUNDATION CONDITIONS MAY HAVE BEEN AFFECTED BY PREVIOUS FAILURES. VERY STEEP FOUNDATION TERRAIN.
PROPAGATION: NOT KNOWN

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:500
PRE - FAILURE:
POST - FAILURE: 1:2500 PRE OR POST UNCLEAR
FAILURE VOLUME: 580 CUBIC METRES x 1000
RUN-OUT DISTANCE: 580 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: WET FINE GRAINED DEBRIS FROM
SPECIAL FEATURES: PREVIOUS SLIP
TYPICAL TRANSVERSE SECTION: P.C.
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS:

AIR PHOTOS - NUMBERS: G.A.S.L. WP9015-2-23
- REMARKS:

GROUND PHOTOS: AVAILABLE

SOURCE OF DATA: GOLDER QUARTERLY REVIEW 862-1409
GOLDER ASSOCIATES 792-1120

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 89
MINE NAME: WESTAR GREENHILLS
DUMP DESIGNATION: 2100 PLATFORM
LOCATION: NORTH DUMP

PRE-FAILURE CONDITION

CREST ELEVATION: 2100 M
TOE ELEVATION: 1950 M
DUMP FACE HEIGHT: 150 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 24 DEG
- PROFILE: B/A
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 07/01/85
WEATHER:
FAILURE TRIGGER: STEEP FOUNDATION, HIGH RATE OF LOADING AND POOR ROCK QUALITY.

PROPAGATION: HIGH LOADING RATE ON SURFICIAL ORGANIC SOIL; FLOW DOWN VALLEY.

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE: OUTLINE ON ORIGINAL
POST - FAILURE: OUTLINE ON ORIGINAL
FAILURE VOLUME: 300 CUBIC METRES x 1000
RUN-OUT DISTANCE: 1200 M. FROM TOE
RUNOUT SHAPE: DEFL.
RUNOUT PATH SURFICIAL SOIL: ORGANIC, SATURATED
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: WEAK VALLEY FLOOR SOIL DISTURBED AND DISPLACED 350 M BEYOND WASTE ROCK DISTAL REGION.

AIR PHOTOS - NUMBERS:
- REMARKS: N/A
GROUND PHOTOS: AVAILABLE

SOURCE OF DATA: GOLDER ASSOCIATES REPORT 862-1409
GOLDER ASSOCIATES REPORT 852-1551

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 112
MINE NAME: QUNITETTE
DUMP DESIGNATION: 1690 N DUMP
LOCATION: MARMOT

PRE-FAILURE CONDITION

CREST ELEVATION: 1690 M
TOE ELEVATION: 1440 M
DUMP FACE HEIGHT: 250 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 12-17 DEG
- PROFILE: CONCAVE A
- MATERIAL: COLLUVIUM/OVER TILL/BEDROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 08/17/84
WEATHER: AUG 5-15 26MM PRECIP.
FAILURE TRIGGER: REGRESSIVE WITH 3-4 DISTINCTLY SEPARATE SLIDES.

PROPAGATION: NOT CONSIDERED A MAJOR EVENT.

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE: INFER FROM CREST PLAN AND PROFILE
POST - FAILURE: CHECK OTHER FILES
FAILURE VOLUME: 1500 CUBIC METRES x 1000
RUN-OUT DISTANCE: 740 M. FROM TOE
RUNOUT SHAPE: SLIGHT CURVE
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM/TILL
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: UNCONFINED
NATURE OF RUNOUT DEBRIS: INITIALLY COARSE AND COMPETENT
VELOCITY ESTIMATE:

COMMENTS:

AIR PHOTOS - NUMBERS: G.A.S.L. 8806025-3-95
- REMARKS: SEE FIGURE 54P
GROUND PHOTOS:

SOURCE OF DATA: PITEAU REPORT (923-11, AUG 23/84)

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 113
MINE NAME: QUINTETTE
DUMP DESIGNATION: 1690 (MARMOT DUMP)
LOCATION: MARMOT

PRE-FAILURE CONDITION

CREST ELEVATION: 1690 M
TOE ELEVATION: 1450 M
DUMP FACE HEIGHT: 240 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 21 DEG
- PROFILE: A CONCAVE
- MATERIAL: COLLUVIUM, SLIDE DEBRIS
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 10/04/85
WEATHER: 200MM OVER PRECEEDING 2 MONTHS
FAILURE TRIGGER: SAME AREA AS PREVIOUS AUG/84 EVENT, ? OLD SNOW

PROPAGATION: NOTE BULLDOZING OF BLOCKS OF GLACIAL TILL

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE: CREST LOCATION KNOWN
POST - FAILURE:
FAILURE VOLUME: 2200 CUBIC METRES x 1000
RUN-OUT DISTANCE: 1180 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM & TILL
SPECIAL FEATURES: TILL BLOCKS PUSHED UP
TYPICAL TRANSVERSE SECTION: UNCONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: WET WEATHER, POOR QUALITY ROCK AND STEEP FOUNDATION. PREVIOUS SLIDE IN SAME AREA.

AIR PHOTOS - NUMBERS: G.A.S.L. G8806025-3-95
- REMARKS: REFER FIGURE 54P
GROUND PHOTOS:

SOURCE OF DATA: PITEAU REPORT 923-15 (NOV/85)

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 153
MINE NAME: FCL
DUMP DESIGNATION: STAGE 2 ACCESS ROADWAY
LOCATION: SOUTH SPOIL

PRE-FAILURE CONDITION

CREST ELEVATION: 2140 M
TOE ELEVATION: 2010 M
DUMP FACE HEIGHT: 130 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 26 DEG
- PROFILE: TYPE A
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: INACTIVE

FAILURE DATA

DATE: 05/29/90
WEATHER: 73MM RAIN IN THIS PERIOD
FAILURE TRIGGER: STEEP TERRAIN, WITH EXCESS PORE PRESSURE GENERATED BY SHEAR IN COLLUVIUM
PROPAGATION:

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: CREST LOC. ONLY
POST - FAILURE: DEBRIS EXTENT ONLY
FAILURE VOLUME: 250 CUBIC METRES x 1000
RUN-OUT DISTANCE: 500 M. FROM TOE
RUNOUT SHAPE: LINEAR
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM ON ROCK OR TILL
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: NO DUMPING UP TO 2 WEEKS PRIOR. HIGHER % OF FINES IN UPPER 1/3

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT ENLARGEMENT, REFER FIGURE 153P
GROUND PHOTOS:

SOURCE OF DATA: FCL REPORT TO INSPECTOR

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 154
MINE NAME: FCL
DUMP DESIGNATION: STAGE 2 ACCESS ROADWAY
LOCATION: SOUTH SPOIL

PRE-FAILURE CONDITION

CREST ELEVATION: 2150 M
TOE ELEVATION: 2020 M
DUMP FACE HEIGHT: 130 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 28 DEG
- PROFILE: TYPE A
- MATERIAL: COLLUVIUM ON ROCK
PRECEDING ACTIVITY: INACTIVE

FAILURE DATA

DATE: 07/07/90
WEATHER: WET JUL/6 HEAVY RAIN, DORMANT 4-6 MO PRIOR TO FAILURE.
FAILURE TRIGGER: STEEP FOUNDATION, WET WEATHER LEADING TO EXCESS PORE PRESSURE IN COLLUVIUM
PROPAGATION: RAN OVER PREVIOUS DEBRIS - BLACKSTONE (1985).

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:2000
PRE - FAILURE: DUMP CREST LOCATION
POST - FAILURE: DEBRIS OUTLINE
FAILURE VOLUME: 300 CUBIC METRES x 1000
RUN-OUT DISTANCE: 690 M. FROM TOE
RUNOUT SHAPE: CURVED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM ON ROCK/TILL
SPECIAL FEATURES: PREVIOUS SLIDE
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: CREST SETTLED PRIOR, AND WAS BUILT UP 5-10 M.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: OPTHOSHOT ENLARGEMENT, REFER FIGURE 154P
GROUND PHOTOS: AVAILABLE

SOURCE OF DATA: GA 902-1175 REPORT

COMPILED BY: A. KENT
DATE: 09/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 155
MINE NAME: FCL
DUMP DESIGNATION: SOUTH SPOIL
LOCATION:

PRE-FAILURE CONDITION

CREST ELEVATION: 2195 M
TOE ELEVATION: 1860 M
DUMP FACE HEIGHT: 335 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 23 DEG
- PROFILE: A/B
- MATERIAL: THIN COLLUVIUM ON ROCK
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 10/26/89
WEATHER:
FAILURE TRIGGER: DOUBLE WEDGE, BASE OVERSTRESSED. 3D EFFECT ON STABILITY IMPORTANT

PROPAGATION: RAPID FAILURE BRANCHES BLOWN FROM TREES ESTIMATED @ >100 KM/HR (DUST ON PLANTS)

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000 COMPOSITE
PRE - FAILURE: ESTIMATED
POST - FAILURE: 1:5000 PARTIAL COVERAGE
FAILURE VOLUME: 2500 CUBIC METRES x 1000
RUN-OUT DISTANCE: 850 M. FROM TOE
RUNOUT SHAPE: FANNED OUT
RUNOUT PATH SURFICIAL SOIL: OLD SPOIL, WET COLLUVIUM
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: UNCONFIRMED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: NOTE IN ZONE (A) RELATIVELY LITTLE DEBRIS DEPOSITED IN CREEK BED. SLIDE DEBRIS DEPOSITED IN CREEK BED I.E. SUFFICIENT MOMENTUM SO THAT MOST OF DEBRIS DEPOSITED ON SOUTH SIDE OF RIVER. SLIDE DEBRIS COVERED AREA 660 M WIDE, BUT INITIAL WIDTH OF FAILING TOE 250 M WIDE.

AIR PHOTOS - NUMBERS: N/A
- REMARKS: ORTHOSHOT AVAILABLE
GROUND PHOTOS: REFER FIGURE 155P

SOURCE OF DATA:
GOLDER ASSOCIATES 892-1277 REPORT FAILURE ANALYSIS
GOLDER ASSOCIATES 872-1036 DESIGN, TOPO
C. BRAWNER REPORT TO FCL, NOVEMBER 14, 1989

COMPILED BY: A. KENT
DATE: 08/30/91
UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 156
MINE NAME: WESTAR GREENHILLS
DUMP DESIGNATION: 2025 PLATFORM
LOCATION: NORTH DUMP

PRE-FAILURE CONDITION

CREST ELEVATION: 2025 M
TOE ELEVATION: 1765 M
DUMP FACE HEIGHT: 260 M
QUALITY OF WASTE: POOR/MEDIUM
FOUNDATION - TOE SLOPE: 25-30 DEG
- PROFILE: TYPE A
- MATERIAL: COLLUVIUM ON ROCK, VALLEY FLOOR ORGANICS
PRECEDING ACTIVITY: INFREQUENT

FAILURE DATA

DATE: 11/22/89
WEATHER:
FAILURE TRIGGER: TOE ADVANCED ONTO 5-10 M THICKNESS OF ORGANIC SOIL DISPLACED BY PREVIOUS FAILURE. CAUSE WAS EXCESS PORE PRESSURE IN THIS MATERIAL.
PROPAGATION: REFER TO PREVIOUS JULY 1985 FAILURE. RUNOUT CROSS SECTIONS AVAILABLE.

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE: REF. FIGURE 1 GA 892-1406A (DEC 1989)
POST - FAILURE: REF. FIGURE 2 GA 892-1406 (APR 1990)
FAILURE VOLUME: 1500 CUBIC METRES x 1000
RUN-OUT DISTANCE: 1950 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: SATURATED, ORGANIC
SPECIAL FEATURES: VERY FLAT GRADE
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE: 70 KM/HR.

COMMENTS: UNUSUALLY FLAT RUNOUT ZONE INCLINED AT LESS THAN 4 DEG. TERMINUS DEBRIS VERY SOFT. SUPER ELEVATION AT CURVE INDICATES 70 KPH VELOCITY

AIR PHOTOS - NUMBERS: WP 9015-1-13 (G.A.S.L.)
- REMARKS: CHECK POST FAILURE FLIGHT
GROUND PHOTOS:

SOURCE OF DATA: GOLDER ASSOCIATES 892-1406A REPORT (DEC/89)

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 157
MINE NAME: QUINTETTE
DUMP DESIGNATION: 1660 WN/A
LOCATION: WOLVERINE NORTH

PRE-FAILURE CONDITION

CREST ELEVATION: 1660 M
TOE ELEVATION: 1400 M
DUMP FACE HEIGHT: 260 M
QUALITY OF WASTE: POOR
FOUNDATION - TOE SLOPE: 13 DEG
- PROFILE: V. SLIGHT CONCAVE
- MATERIAL: COLLUVIUM
PRECEDING ACTIVITY: ACTIVE

FAILURE DATA

DATE: 11/07/87
WEATHER: 18MM OCT 28 - NOV 3; 3MM NOV 3
FAILURE TRIGGER: SHEAR ON DUMP FOUNDATION CONTACT, WITH EXCESS PORE WATER PRESSURE. RAINFALL A TRIGGER BUT FOS LOW DUE TO OTHER FACTORS
PROPAGATION: FOUNDATION SHEAR STRAIN GENERATED ADDITIONAL PORE PRESSURE

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: 1:5000
PRE - FAILURE: POSITION OF CREST & TOE ONLY
POST - FAILURE: 1:1250 (QCL DWG. 87-200-27-001)
FAILURE VOLUME: 5600 CUBIC METRES x 1000
RUN-OUT DISTANCE: 2500 M. FROM TOE
RUNOUT SHAPE: DEFLECTED
RUNOUT PATH SURFICIAL SOIL: PART OLD SLIP DEBRIS/COLLUVIUM
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: PART CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS: USED AIR PHOTOS TO ESTIMATE EXTENT OF RUNOUT

AIR PHOTOS - NUMBERS: G9003006.5.49..55,G8806025.5-55..56 POST
- REMARKS: G9003006.4.30..37 POST,WP8742.3.26..32
GROUND PHOTOS:

SOURCE OF DATA: GOLDER ASSOCIATES 872-1263 FEB/88

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER:	158
MINE NAME:	QUINTETTE
DUMP DESIGNATION:	1680 WW
LOCATION:	WOLVERINE WEST

PRE-FAILURE CONDITION

CREST ELEVATION:	1680	M
TOE ELEVATION:	1440	M
DUMP FACE HEIGHT:	240	M
QUALITY OF WASTE:	POOR	
FOUNDATION - TOE SLOPE:	33 DEG	
- PROFILE:	A-B-A-B	
- MATERIAL:	COLLUVIUM ON ROCK	
PRECEDING ACTIVITY:	ACTIVE	

FAILURE DATA

DATE:	05/13/88
WEATHER:	WET PRIOR, SPRING MELT
FAILURE TRIGGER:	PORE PRESSURE IN FOUNDATION COLLUVIUM
PROPAGATION:	RAPID TOE LOADING AS MATERIAL ON STEEP UPPER SLOPES LOST SUPPORT

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL:	SEE QCL MAP Y31	
PRE - FAILURE:	ESTIMATE FROM REPORT	
POST - FAILURE:	NOT AVAILABLE CHECK	
FAILURE VOLUME:	80	CUBIC METRES x 1000
RUN-OUT DISTANCE:	790	M. FROM TOE
RUNOUT SHAPE:	DEFLECTED	
RUNOUT PATH SURFICIAL SOIL:	COLLUVIUM	
SPECIAL FEATURES:		
TYPICAL TRANSVERSE SECTION:	CONFINED	
NATURE OF RUNOUT DEBRIS:	PROBABLY GOOD, HIGH DEG. SEGR	
VELOCITY ESTIMATE:		

COMMENTS: DUMP TOE WAS ALREADY KEYED INTO VALLEY FLOOR

AIR PHOTOS - NUMBERS: G8806025-5-51,49
- REMARKS: G9003006-4-29, G9003006-5-45..48

GROUND PHOTOS:

SOURCE OF DATA: GOLDER ASSOCIATES 882-1146A

COMPILED BY:	A. KENT	UPDATED BY:	
DATE:	08/30/91	DATE:	/ /

MINE WASTE DUMP FAILURE
RUNOUT DATA SUMMARY

LOCATION

EVENT NUMBER: 162
MINE NAME: FCL
DUMP DESIGNATION: F. GULLY
LOCATION: BROWNIE

PRE-FAILURE CONDITION

CREST ELEVATION: 2350 M
TOE ELEVATION: 2180 M
DUMP FACE HEIGHT: 170 M
QUALITY OF WASTE:
FOUNDATION - TOE SLOPE: 33 DEG
- PROFILE: A/C
- MATERIAL: COLLUVIUM/ROCK
PRECEDING ACTIVITY:

FAILURE DATA

DATE: 06/01/83
WEATHER:
FAILURE TRIGGER: STEEP FOUNDATION

PROPAGATION:

RUNOUT DATA

SURFACE TOPOGRAPHY - ORIGINAL: REF. EVENT 5
PRE - FAILURE:
POST - FAILURE:
FAILURE VOLUME: N.A.
RUN-OUT DISTANCE: 870 M. FROM TOE
RUNOUT SHAPE: CURVED
RUNOUT PATH SURFICIAL SOIL: COLLUVIUM/TILL/ROCK
SPECIAL FEATURES:
TYPICAL TRANSVERSE SECTION: CONFINED
NATURE OF RUNOUT DEBRIS:
VELOCITY ESTIMATE:

COMMENTS:

AIR PHOTOS - NUMBERS:
- REMARKS: ORTHOSHOT AVAILABLE

GROUND PHOTOS:

SOURCE OF DATA:

COMPILED BY: A. KENT
DATE: 08/30/91

UPDATED BY:
DATE: / /

WEATHER RECORDS

WEATHER RECORD

EVENT: 1 , 162
STATION : FORDING RIVER – COMINCO
MONTH : MAY
YEAR: 1983

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5			0
6			0
7			0
8			0
9			0
10	7.7		7.7
11			0
12			0
13			0
14			0
15			0
16			0
17			0
18			0
19			0
20			0
21	5.6		5.6
22			0
23			0
24			0
25			0
26			0
27			0
28			0
29			0
30			0
31	1		1
TOTAL :	14.3	0	14.3

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH1.wk2

WEATHER RECORD

STATION :FORDING RIVER EVENT : 1,162
MONTH :JUNE YEAR : 1983

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1	3		3
2	12.4		12.4
3	15		15
4	2		2
5			0
6	1.4		1.4
7			0
8	4.4		4.4
9			0
10			0
11			0
12	2.8		2.8
13			0
14			0
15	1.2		1.2
16			0
17			0
18			0
19	7.6		7.6
20	1.4		1.4
21	2		2
22	9.9		9.9
23	7.8		7.8
24			0
25			0
26			0
27	2.6		2.6
28			0
29	2.5		2.5
30	7		7
31			0
TOTAL :	83	0	83

Note : Above records transcribed from climatological records held on file.

WEATHER SUMMARY FOR THE YEAR OF 1983

1983
Cominco

STATION: FORDING RIVER - COMINCO (Plant Site)
ELEVATION: 1,702 m
TEMPERATURE: °C

MONTH	MEANS			EXTREMES		PRECIPITATION		
	MAX.	MIN.	MEAN	MAX.	MIN.	RAIN mm	SNOW cm	TOTAL mm
Jan.	-0.5	-9.4	-4.95	6.0	-16.5	---	34.0	34.0
Feb.	0.4	-5.95	-2.78	6.0	-18.0	---	5.0	5.0
Mar.	1.6	-5.7	-2.10	7.0	-17.0	---	---	---
Apr.	4.1	-5.7	0.80	13.0	-14.0	---	20.0	20.0
May	9.3	-1.5	3.90	22.0	-7.0	14.3	---	14.3
June	18.1	3.9	11.0	20.5	0	82.6	---	82.6
July	17.5	5.7	11.6	27.0	1.0	54.9	---	54.9
Aug.	22.5	8.0	15.25	29.0	1.0	21.9	---	21.9
Sept.	11.0	-0.4	5.3	19.0	-10.0	20.8	30.0	50.8
Oct.	5.7	-1.8	-2.0	13.0	-6.5	19.6	9.0	28.6
Nov.	-3.57	-6.83	-5.20	7.0	-15.0	36.4	12.0	48.4
Dec.	-13.9	-21.1	-17.5	-2.0	-40.0	---	30.4	30.4
			TOTAL PRECIPITATION			250.5	140.4	390.9

FORDING RIVER BELOW CLODE CREEK - STATION NO. 08NK021

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1983

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.167B	0.160	0.154	0.228	1.47	7.15	2.25	1.16	0.621	0.398E	0.288A	0.146B
2	0.161B	0.155	0.153	0.230	1.41	5.80	2.12	1.11	0.627	0.390E	0.333E	0.143B
3	0.162B	0.152	0.151	0.236	1.41	6.79	2.36	1.03	0.611	0.390E	0.420E	0.140B
4	0.163B	0.150B	0.153	0.235	1.40	6.98	2.89	0.975	0.618	0.390E	0.578A	0.137B
5	0.164B	0.147B	0.157	0.238	1.43	6.67	3.42	0.934	0.618	0.385E	0.553E	0.13[illegible]B
6	0.165B	0.141B	0.159	0.241	1.56	6.48	3.33	0.915	0.598	0.380A	0.540E	0.132B
7	0.167B	0.145B	0.160	0.249	1.85	6.60	4.13	0.891	0.644	0.370E	0.521A	0.130B
8	0.171B	0.146B	0.161	0.254	1.92	6.42	3.76	0.879	0.617	0.360E	0.510A	0.134B
9	0.176	0.149B	0.186	0.256	1.83	5.92	3.06	0.874	0.588	0.350E	0.500A	0.140
10	0.183	0.151B	0.225	0.256	1.70	5.16	2.56	0.905	0.554	0.344E	0.480E	0.1[illegible]1
11	0.179	0.156	0.218	0.247	1.71	4.55	2.31	0.873	0.503	0.336A	0.460E	0.147
12	0.172	0.148	0.197	0.245	1.87	4.03	2.31	0.828	0.467	0.412A	0.440E	0.149
13	0.169	0.149	0.202	0.261	2.15	3.38	2.34	0.787	0.460	0.324A	0.430E	0.148
14	0.165B	0.151	0.203	0.237	2.43	3.41	2.34	0.759	0.461	0.320A	0.420A	0.154
15	0.161B	0.149	0.205	0.241	2.61	3.55	2.08	0.747	0.467	0.320E	0.400A	0.153B
16	0.159B	0.154	0.206	0.258	2.61	3.17	2.08	0.781	0.464	0.316E	0.380A	0.151B
17	0.160B	0.147	0.198	0.297	2.87	3.09	2.15	0.768	0.477	0.312E	0.380A	0.144B
18	0.162B	0.144	0.192	0.393	3.15	3.12	2.10	0.811	0.481	0.308A	0.370E	0.145B
19	0.167B	0.148	0.204	0.636	2.94	2.55	2.04	0.749	0.460	0.300A	0.350E	0.142B
20	0.188	0.143	0.197	1.12	3.09	2.26	1.96	0.730	0.433	0.300A	0.315E	0.139B
21	0.183	0.143	0.189	1.62	4.40	2.01	1.85	0.701	0.417	0.297A	0.273A	0.136B
22	0.169	0.146	0.182	2.06	5.19	2.01	1.74	0.706	0.396	0.303E	0.258A	0.133B
23	0.165	0.140	0.195	2.24	6.[illegible]8	2.65	1.68	0.718	0.390	0.313E	0.198A	0.130B
24	0.170	0.153	0.209	3.54	7.02	4.05	1.65	0.743	0.375	0.300A	0.178	0.127B
25	0.164	0.171	0.210	3.48	9.01	3.14	1.66	0.733	0.363	0.291A	0.163	0.128B
26	0.157	0.165	0.228	2.50	10.4	2.59	1.59	0.716	0.357	0.285A	0.157B	0.130B
27	0.159	0.159	0.230	2.04	10.4	2.48	1.45	0.680	0.429	0.279	0.155B	0.131B
28	0.156	0.154	0.223	1.78	9.93	2.41	1.38	0.686	0.448A	0.282A	0.153B	0.130B
29	0.174		0.225	1.64	10.7	2.44	1.32	0.670	0.423E	0.274E	0.151B	0.130B
30	0.171		0.230	1.60	10.4	2.38	1.27	0.648	0.406E	0.269E	0.149B	0.132B
31	0.166		0.230		4.45		1.23	0.625		0.264A		0.136B
TOTAL	5.195	4.219	6.030	28.839	133.79	123.42	68.41	25.135	14.793	10.162	10.508	4.299
MEAN	0.168	0.151	0.195	0.961	4.32	4.11	2.21	0.811	0.493	0.328	0.350	0.139
MAX	0.188	0.171	0.230	3.54	10.7	7.15	4.13	1.16	0.644	0.412	0.578	0.154
MIN	0.156	0.140	0.151	0.228	1.40	2.01	1.23	0.625	0.357	0.264	0.149	0.127

SUMMARY FOR THE YEAR 1983

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 1.19
MAXIMUM DAILY, 10.7 ON MAY 29
MINIMUM DAILY, 0.127B ON DEC 24
MAXIMUM INSTANTANEOUS,
12.5 AT 23:35 MST ON MAY 29

TYPE OF GAUGE - RECORDING
LOCATION - LAT 50 12 05 N
LONG 114 52 57 W
DRAINAGE AREA, 104 km²
A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED
NATURAL FLOW

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	449	JUL	5 910
FEB	365	AUG	2 170
MAR	521	SEP	1 280
APR	2 490	OCT	878
MAY	11 600	NOV	908
JUN	10 700	DEC	371

TOTAL DISCHARGE, 37 600 dam³

WEATHER RECORD

EVENT: 3
STATION : FORDING RIVER
MONTH : AUGUST
YEAR: 1984

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5			0
6	3.8		3.8
7			0
8			0
9			0
10			0
11			0
12	1.6		1.6
13			0
14			0
15			0
16			0
17			0
18	2.2		2.2
19	2.2		2.2
20			0
21			0
22			0
23			0
24			0
25			0
26			0
27	9.6		9.6
28	0.4		0.4
29			0
30			0
31			0
TOTAL :	19.8	0	19.8

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH3.wk2

WEATHER RECORD

EVENT: 3
STATION : FORDING RIVER
MONTH : SEPT
YEAR: 1983

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3	4.5		4.5
4			0
5	7.5		7.5
6	7.5		7.5
7			0
8	2.5		2.5
9	2.5		2.5
10	5.5		5.5
11	5.8		5.8
12	1		1
13			0
14			0
15	1		1
16			0
17			0
18			0
19			0
20	13	9.5	22.5
21			0
22			0
23			0
24			0
25		6.5	6.5
26		3	3
27			0
28			0
29			0
30			0
TOTAL	50.8	19	69.8

AHK/ak
Disk/WEATH3A.wk2

WEATHER RECORD

EVENT: 5
STATION : FORDING RIVER
MONTH : JUNE
YEAR: 1984

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4	3		3
5	1.8		1.8
6	5.2		5.2
7	15.6		15.6
8			0
9			0
10	17.5		17.5
11			0
12	0.3		0.3
13			0
14			0
15	0.3		0.3
16			0
17			0
18	11		11
19			0
20			0
21			0
22	5		5
23	1.6		1.6
24	9.6		9.6
25			0
26	1.8		1.8
27			0
28			0
29	2.2		2.2
30			0
31			0
TOTAL :	74.9	0	74.9

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH5.wk2

WEATHER RECORD

EVENT: 5
STATION : FORDING RIVER
MONTH : JULY
YEAR: 1984

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4	5.2		5.2
5			0
6			0
7			0
8	0.1		0.1
9			0
10			0
11			0
12			0
13			0
14			0
15			0
16			0
17			0
18			0
19			0
20			0
21			0
22			0
23	8.5		8.5
24			0
25			0
26			0
27	0.5		0.5
28	4		4
29	3.6		3.6
30			
31			
TOTAL	21.9	0	21.9

AHK/ak
Disk/WEATH5A.wk2

③ ⑤ ⑨

FORDING RIVER BELOW C.ODE CREEK - STATION NO 08NK021

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1984

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.141B	0.144	0.131	0.202	0.809	5.93	3.83	1.14	0.481	0.515	0.252	0.196B
2	0.146B	0.141	0.131	0.210	0.773	4.91	3.21	1.13	0.467	0.539	0.239	0.193B
3	0.159B	0.137	0.131	0.217	0.775	5.18	3.28	1.08	0.463	0.578	0.223	0.186B
4	0.155	0.147	0.134	0.236	0.732	4.84	3.31	1.05	0.467	0.624	0.218	0.180B
5	0.204	0.149	0.135	0.273	0.740	5.21	3.24	1.01	0.420	0.684	0.255	0.173B
6	0.183	0.144	0.136	0.278	0.735	5.34	3.71	1.00	0.455	0.662	0.344	0.170B
7	0.174	0.141	0.143	0.276	0.744	5.61	3.18	0.966	0.464	0.658	0.385	0.174B
8	0.174	0.138	0.152	0.288	0.778	6.19	2.72	0.907	0.452	0.665	0.378	0.180
9	0.180	0.132	0.162	0.289	0.852	6.39	2.58	0.878	0.447	0.723	0.346	0.176
10	0.180	0.131	0.172	0.281	0.836	5.71	2.52	0.860	0.461	0.714	0.339	0.177B
11	0.183	0.128	0.179	0.272	0.816	6.07	2.79	0.854	0.515A	0.695	0.339	0.175B
12	0.177	0.128	0.164	0.268	0.794	6.63	2.76	0.801	0.526	0.676	0.363	0.173B
13	0.172B	0.131	0.154	0.279	0.811	7.78	2.52	0.770	0.518	0.674	0.368	0.171B
14	0.164B	0.126	0.157	0.308	1.31	8.46	2.32	0.737	0.492	0.624	0.358	0.173B
15	0.157B	0.127	0.149	0.430	2.89	10.2	2.20	0.695	0.490	0.585	0.326	0.174B
16	0.155B	0.140	0.166	1.23	4.37	9.73	2.14	0.661	0.469	0.567	0.292	0.171B
17	0.150B	0.136B	0.177	2.55	3.61	7.80	2.12	0.645	0.460	0.541	0.256	0.167B
18	0.145B	0.133B	0.182	2.30	3.12	7.16	2.03	0.660	0.532	0.537	0.222	0.163B
19	0.141B	0.131B	0.192	1.72	3.09	6.86	1.89	0.663	0.564	0.516	0.207	0.161B
20	0.137B	0.134B	0.221	1.51	3.39	6.82	1.73	0.625	0.618	0.459	0.222	0.161B
21	0.135B	0.140	0.237A	1.64	3.08	6.91	1.66	0.589	0.745	0.402	0.245	0.164B
22	0.136B	0.142	0.257	1.86	2.75	5.89	1.46	0.573	0.685	0.442	0.261	0.169B
23	0.139B	0.139	0.242	1.74	2.82	6.18	1.37	0.536	0.659	0.415	0.274	0.167B
24	0.142B	0.144	0.220	1.48	2.58	7.68	1.37	0.533	0.632	0.425	0.264	0.165B
25	0.145B	0.136	0.200	1.34	2.51	8.03	1.39	0.527	0.618	0.429	0.272	0.167B
26	0.147B	0.134	0.191	1.26	2.38	7.52	1.37	0.505	0.585	0.422	0.253	0.172B
27	0.152B	0.136	0.193	1.13	2.29	7.94	1.38	0.539	0.536	0.350	0.230	0.170B
28	0.159	0.132	0.195	1.02	2.38	7.66	1.31	0.590	0.519	0.310	0.206	0.167B
29	0.157	0.136	0.190	0.891	3.77	7.96	1.29	0.548	0.520	0.315	0.201	0.164B
30	0.152		0.189	0.834	9.09	5.86	1.25	0.526	0.511	0.281	0.198B	0.161B
31	0.155		0.197		9.65		1.19	0.501		0.280		0.158B
TOTAL	4.938	3.963	5.499	26.612	75.375	204.45	69.12	23.099	15.791	16.347	8.336	5.320
MEAN	0.159	0.137	0.177	0.887	2.43	6.82	2.23	0.745	0.526	0.527	0.278	0.172
MAX	0.204	0.149	0.257	2.55	9.65	10.2	3.83	1.14	0.745	0.723	0.385	0.196
MIN	0.135	0.126	0.131	0.202	0.732	4.84	1.19	0.501	0.420	0.280	0.198	0.158

SUMMARY FOR THE YEAR 1984

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 1.25
MAXIMUM DAILY, 10.2 ON JUN 15
MINIMUM DAILY, 0.126 ON FEB 14
MAXIMUM INSTANTANEOUS,
13.7 AT 23:34 MST ON MAY 30

TYPE OF GAUGE - RECORDING
LOCATION - LAT 50 12 05 N
LONG 114 52 57 W
DRAINAGE AREA, 104 km²
A - MANUAL GAUGE
B - ICE CONDITIONS

NATURAL FLOW

MONTHLY TOTAL DISCHARGE IN CUBIC DECAMETRES

JAN	427	JUL	5 570
FEB	342	AUG	2 000
MAR	475	SEP	1 360
APR	2 300	OCT	1 410
MAY	6 510	NOV	720
JUN	17 700	DEC	460

TOTAL DISCHARGE, 39 700 dam³

WATER SURVEY OF CANADA
FEB 19 1986 PAGE 9
VANCOUVER, B.C. 15:21

FORDING RIVER BELOW CLODE CREEK

16, 7, 11, 6, 15

Dec 21 '84 [illegible]

(~~PRELIMINARY~~) DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1985

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.152 B	0.109 B	0.112 B	0.291	1.66	6.15	2.34	0.657	0.722	0.936	0.761	0.300 B	1
2	0.150 B	0.108 B	0.103 B	0.340	2.56	5.51	2.19	0.675	0.699	0.915	0.752	0.300 B	2
3	0.150 E	0.106 B	0.107 B	0.395	4.27	4.93	2.11	0.649	0.685	0.903	0.861	0.304 B	3
4	0.156 E	0.105 B	0.102 B	0.353	4.67	4.55	2.04	0.634	0.701	0.675	0.913	0.311	4
5	0.162 E	0.109 B	0.114 B	0.340	3.66	4.30	1.96	0.648	0.789	0.537	0.774	0.310	5
6	0.170 E	0.111 B	0.123	0.338	3.59	4.41	1.84	0.624	0.576	0.657	0.737	0.310	6
7	0.172 A	0.112 B	0.125	0.346	3.75	5.10	1.55	0.591	0.695	0.767	0.560	0.316	7
8	0.166	0.111 B	0.125	0.354	4.24	6.21	1.60	0.630	0.680	0.750	0.467	0.312 B	8
9	0.179	0.110 B	0.125	0.445	4.22	4.90	1.50	0.636	0.660	0.518	0.401	0.305 B	9
10	0.171	0.111 B	0.125	0.576	4.11	4.23	1.47	0.674	0.646	0.730	0.362	0.300 B	10
11	0.170	0.113 B	0.134	1.14	3.84	3.92	1.40	0.647	0.594	0.720	0.347	0.300 B	11
12	0.168	0.115 B	0.137	1.25	3.39	4.33	1.33	0.724	2.49	0.713	0.329	0.300 B	12
13	0.162	0.115 B	0.150	1.88	3.25	4.38	1.27	0.749	3.92	0.694	0.304	0.300 B	13
14	0.157	0.120 B	0.162	2.47	3.59	4.20	1.19	0.730	2.85	0.703	0.296	0.300 B	14
15	0.153	0.124	0.163	2.01	3.86	4.50	1.11	0.911	2.26	0.717	0.310	0.300 B	15
16	0.149	0.126	0.217	1.75	5.19	4.34	1.11	1.02	1.98	0.766	0.355	0.300 B	16
17	0.153	0.125	0.411	1.71	6.75	3.90	1.23	1.09	1.82	0.765	0.342 B	0.299	17
18	0.151	0.124	0.564	1.51	8.35	4.05	1.09	1.21	1.59	0.725	0.341 B	0.295	18
19	0.156	0.123	0.663	1.39	9.38	4.43	1.03	1.20	1.47	0.713	0.340 B	0.291	19
20	0.151	0.122	0.565	1.25	9.69	4.35	0.979	1.09	1.37	0.733	0.334 B	0.290	20
21	0.145	0.119	0.433	1.12	9.95	3.37	0.937	1.11	1.32	0.742	0.327 B	0.289	21
22	0.148	0.118	0.349	1.07	9.82	3.07	0.919	1.14	1.27	0.754	0.321 B	0.280	22
23	0.150	0.118	0.275	1.03	9.52	3.02	0.911	1.23	1.22	0.758	0.324 B	0.282	23
24	0.143	0.117	0.242	0.967	9.65	2.57	0.951	1.19	1.16	0.740	0.329 B	0.269	24
25	0.144	0.114	0.227	0.907	9.47	2.20	0.838	1.08	1.12	0.790	0.330 B	0.282	25
26	0.146	0.115	0.225	0.934	8.03	2.23	0.732	0.997	1.12	0.676	0.325 B	0.256	26
27	0.145	0.117	0.227	0.653	6.54	2.32	0.745	0.927	1.07	0.769	0.327 B	0.281	27
28	0.143	0.113	0.213	1.04	6.17	2.47	0.729	0.864	1.01	0.947	0.320 B	0.293	28
29	0.130 B		0.233	1.27	5.59	2.58	0.713	0.810	0.972	0.797	0.315 B	0.264	29
30	0.112 B		0.235	1.37	6.48	2.50	0.700	0.778	0.940	0.710	0.305 B	0.282	30
31	0.109 B		0.241		6.39		0.571	0.757		0.717		0.279	31
TOTAL	4.711	3.233	7.241	30.650	132.86	119.63	39.285	26.672	39.999	23.844	12.969	9.120	TOTAL
MEAN	0.152	0.115	0.234	1.02	4.29	3.99	1.27	0.860	1.33	0.769	0.433	0.294	MEAN
DAM3	407	279	626	2650	11500	10300	3390	2220	3460	2060	1120	788	DAM3
MAX	0.179	0.126	0.663	2.47	9.95	6.21	2.34	1.23	3.92	0.947	0.913	0.316	MAX
MIN	0.109	0.105	0.107	0.291	1.66	2.20	0.571	0.591	0.685	0.518	0.298	0.256	MIN

SUMMARY FOR THE YEAR 1985
MEAN DISCHARGE, 1.37 M3/S
TOTAL DISCHARGE, 43230 DAM3
MAXIMUM DAILY DISCHARGE, 9.95 M3/S ON MAY 21
MINIMUM DAILY DISCHARGE, 0.106 M3/S ON FEB 3

MAXIMUM INSTANTANEOUS DISCHARGE, 11.4 M3/S AT 00:36 M.S.T. ON May 21 (g.h. 1.259).

Curve No. 15 all year

A-MANUAL GAUGE
B-ICE CONDITIONS
E-ESTIMATED

PREPARED BY/DATE W. J. Hunt. Feb. 26. 1986.
CHECKED BY/DATE W. J. Hunt. Feb. 26, 1986.

(6)

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FORDING RIVER CLODE CRK        CLIMATE SUMMARY FOR       AUGUST      1985
                        B.C. REGIONAL ID :    24800
                        AES HEADQUARTERS ID : 1152898

               ****************************************************************
          DAY  *      TEMPERATURE       *          TOTAL          * T Z H * SNOW *
               *    MAX    MIN    MEAN  *    RAIN   SNOW     PCP  * H R A * GND  *
               ****************************************************************
            1  *   19.5   11.0   15.3   *                         *       *   0  *
            2  *   18.0    9.0   13.5   *    3.2              3.2 *       *   0  *
            3  *   18.0    8.0   13.0   *                         * X     *   0  *
            4  *   18.0    9.0   13.5   *                         *       *   0  *
            5  *   13.5    5.5    9.5   *    3.0              3.0 *       *   0  *
            6  *   14.0    7.0   10.5   *                         *       *   0  *
            7  *   18.0   11.0   14.5   *    1.8              1.8 *       *   0  *
            8  *    5.5    2.5    4.0   *   10.2             10.2 *       *   0  *
            9  *    6.5    3.0    4.8   *   10.0             10.0 *       *   0  *
           10  *    5.0    3.0    4.0   *    1.4              1.4 *       *   0  *
           11  *   10.0    3.0    6.5   *    6.3              6.3 *       *   0  *
           12  *    8.0    0.0    4.0   *    1.8    1.0       2.8 *       *   0  *
           13  *   11.0    0.0    5.5   *                         *       *   0  *
           14  *   10.5    4.0    7.3   *    4.6    1.0E     5.6E*       *   0  *
           15  *    8.5    0.0    4.3   *   11.0             11.0 *       *   0  *
           16  *   15.5    1.5    8.5   *     .8               .8 *       *   0  *
           17  *   19.0    6.0   12.5   *                         *       *   0  *
           18  *   19.0    9.0   14.0   *                         *       *   0  *
           19  *   15.0    8.0   11.5   *                         *       *   0  *
           20  *   12.5    8.0   10.3   *    3.8    1.0       4.8 *       *   0  *
           21  *    5.0    0.0    2.5   *   11.3             11.3 *       *   0  *
           22  *   10.5    2.0    6.3   *                         *       *   0  *
           23  *   17.0    6.5   11.8   *                         *       *   0  *
           24  *   18.5    9.0   13.8   *                         *       *   0  *
           25  *   19.5   11.0   15.3   *                         *       *   0  *
           26  *   17.0    6.0   11.5   *                         *       *   0  *
           27  *   16.5    6.0   11.3   *                         *       *   0  *
           28  *   16.0    8.0   12.0   *                         *       *   0  *
           29  *   18.0    6.5   12.3   *                         *       *   0  *
           30  *   12.5    8.0   10.3   *                         *       *   0  *
           31  *   11.0    1.5    6.3   *                         *       *   0  *
               ****************************************************************

          TOTAL   426.5 173.0          *    69.2    3.0    72.2 * 1 0 0 *
          MEAN     13.8   5.6    9.7

MONTHLY MAXIMUM TEMPERATURE WAS   19.5 ON DAY   1  25
MONTHLY MINIMUM TEMPERATURE WAS    0.0 ON DAY  12  13  15  21
HIGHEST RAINFALL WAS  11.3 ON DAY  21
HIGHEST SNOWFALL WAS   1.0 ON DAY  12  14  20
MAX TOTAL PRECIP WAS  11.3 ON DAY  21
NUMBER OF DAYS WITH MEASUREABLE PRECIPITATION IS 13
NUMBER OF DAYS WITH MEASUREABLE RAINFALL IS 13
NUMBER OF DAYS WITH MEASUREABLE SNOWFALL IS  3

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS 257.6

LIST OF CODES USED IS AVAILABLE ON REQUEST
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FORDING RIVER CLODE CRK       CLIMATE SUMMARY FOR      SEPTEMBER  1985
                          B.C. REGIONAL ID :    24800
                          AES HEADQUARTERS ID : 1152898


          *****************************************************************
      DAY *      TEMPERATURE     *          TOTAL          * T Z H * SNOW *
          *   MAX    MIN    MEAN *   RAIN   SNOW     PCP   * H R A * GND  *
          *****************************************************************
        1 *   11.5    5.0    8.3 *                         *       *  0   *
        2 *   11.0    3.0    7.0 *                         *       *  0   *
        3 *   11.0    3.5    7.3 *    1.4             1.4  *       *  0   *
        4 *   10.0    4.0    7.0 *    8.2             8.2  *       *  0   *
        5 *    9.0    4.5    6.8 *    3.4    1.5      4.9  *       *  0   *
        6 *    1.5   -6.5   -2.5 *                         *       *  2.  *
        7 *    2.0   -5.5   -1.8 *                         *       *  M   *
        8 *    4.0   -2.5     .8 *                         *       *  M   *
        9 *    5.0    1.5    3.3 *                         *       *  M   *
       10 *   11.0    0.0    5.5 *                         *       *  0   *
       11 *   15.5    2.0    8.8 *   15.0            15.0  *       *  0   *
       12 *    3.0    -.5    1.3 *   20.5            20.5  *       *  0   *
       13 *    5.0    -.5    2.3 *                         *       *  0   *
       14 *    3.0    0.0    1.5 *                         *       *  0   *
       15 *    4.0    -.5    1.8 *     .7              .7  *       *  0   *
       16 *    4.0    -.5    1.8 *     .4    1.0      1.4  *       *  0   *
       17 *    0.0   -3.0   -1.5 *    1.2    1.0      2.2  *       *  1.  *
       18 *   -2.0   -4.0   -3.0 *    1.0    8.5      9.5  *   X   *  2.  *
       19 *    1.0   -4.0   -1.5 *     .6    T         .6  *   X   * 10.  *
       20 *    4.0   -2.0    1.0 *                         *       *  5.  *
       21 *    2.0   -1.0     .5 *                         *       *  M   *
       22 *     .5   -6.0   -2.8 *    3.1E   4.0E     7.1E *       *  M   *
       23 *    0.0   -7.5   -3.8 *                         *       *  2.  *
       24 *    6.0   -2.0    2.0 *    1.1             1.1  *       *  0   *
       25 *    9.5   -1.0    4.3 *                         *       *  0   *
       26 *    5.0   -1.0    2.0 *                         *       *  0   *
       27 *   -7.0  -10.0   -8.5 *                         *       *  0   *
       28 *    2.0  -10.5   -4.3 *                         *       *  0   *
       29 *    7.0   -8.0    -.5 *                         *       *  0   *
       30 *   10.0   -2.0    4.0 *                         *       *  0   *
          *****************************************************************

     TOTAL   148.5  -55.0        *   56.6   16.0     72.6  * 0 2 0 *
     MEAN      4.9   -1.8    1.6

MONTHLY MAXIMUM TEMPERATURE WAS   15.5 ON DAY  11
MONTHLY MINIMUM TEMPERATURE WAS  -10.5 ON DAY  28
HIGHEST RAINFALL WAS  20.5 ON DAY  12
HIGHEST SNOWFALL WAS   8.5 ON DAY  18
MAX TOTAL PRECIP WAS  20.5 ON DAY  12
NUMBER OF DAYS WITH MEASUREABLE PRECIPITATION IS 12
NUMBER OF DAYS WITH MEASUREABLE RAINFALL IS 12
NUMBER OF DAYS WITH MEASUREABLE SNOWFALL IS  5

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS 492.9

LIST OF CODES USED IS AVAILABLE ON REQUEST
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7/16.

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FORDING RIVER COMINCO          CLIMATE SUMMARY FOR       MAY         1985
                         B.C. REGIONAL ID :    25000
                         AES HEADQUARTERS ID : 1152899


            ******************************************************************
        DAY *      TEMPERATURE      *          TOTAL          * T Z H * SNOW *
            *   MAX    MIN    MEAN  *    RAIN   SNOW     PCP  * H R A * GND  *
            ******************************************************************
          1 *   19.0   -5.0    7.0  *                         *       *   0  *
          2 *   21.0   -4.0    8.5  *                         *       *   0  *
          3 *   17.5   -3.0    7.3  *                         *       *   0  *
          4 *    0.0   -3.0   -1.5  *             .5      .5  *       *   0  *
          5 *    5.0   -4.0     .5  *                         *       *   1. *
          6 *   15.0   -5.0    5.0  *                         *       *   0  *
          7 *   14.0   -3.5    5.3  *                         *       *   0  *
          8 *    8.0   -3.0    2.5  *                         *       *   0  *
          9 *    8.0   -4.5    1.8  *                         *       *   0  *
         10 *    9.0   -8.5     .3  *                         *       *   0  *
         11 *    1.0    0.0     .5  *                         *       *   0  *
         12 *    8.0   -3.0    2.5  *                         *       *   0  *
         13 *   16.0   -6.0    5.0  *                         *       *   0  *
         14 *   14.0   -2.0    6.0  *                         *       *   0  *
         15 *   18.0   -3.0    7.5  *                         *       *   0  *
         16 *   20.0   -4.0    8.0  *                         *       *   0  *
         17 *   23.0   -4.0    9.5  *                         *       *   0  *
         18 *   21.0   -1.0   10.0  *                         *       *   0  *
         19 *   19.5   -1.0    9.3  *                         *       *   0  *
         20 *   19.5   -1.0    9.3  *                         *       *   0  *
         21 *   19.0   -2.5    8.3  *                         *       *   0  *
         22 *   23.5   -1.0   11.3  *                         *       *   0  *
         23 *   21.0    1.0   11.0  *                         *       *   0  *
         24 *   18.5    1.0    9.8  *     6.0            6.0  *       *   0  *
         25 *   13.0    3.0    8.0  *                         *       *   0  *
         26 *   10.0    0.0    5.0  *     6.0            6.0  *       *   0  *
         27 *   14.5   -1.5    6.5  *                         *       *   0  *
         28 *   13.0    0.0    6.5  *                         *       *   0  *
         29 *   11.0    2.0    6.5  *    20.5           20.5  *       *   0  *
         30 *   13.0    3.0    8.0  *     1.6            1.6  *       *   0  *
         31 *   16.5    2.5    9.5  *                         *       *   0  *
            ******************************************************************

      TOTAL  449.5 -61.0           *    34.1     .5    34.6  * 0 0 0 *
      MEAN    14.5  -2.0    6.3

MONTHLY MAXIMUM TEMPERATURE WAS   23.5 ON DAY  22
MONTHLY MINIMUM TEMPERATURE WAS   -8.5 ON DAY  10
HIGHEST RAINFALL WAS  20.5 ON DAY  29
HIGHEST SNOWFALL WAS    .5 ON DAY   4
MAX TOTAL PRECIP WAS  20.5 ON DAY  29
NUMBER OF DAYS WITH MEASUREABLE PRECIPITATION IS  5
NUMBER OF DAYS WITH MEASUREABLE RAINFALL IS  4
NUMBER OF DAYS WITH MEASUREABLE SNOWFALL IS  1

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS 363.3

LIST OF CODES USED IS AVAILABLE ON REQUEST
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FORDING RIVER COMINCO          CLIMATE SUMMARY FOR      JUNE        1985
                       B.C. REGIONAL ID :    25000
                       AES HEADQUARTERS ID : 1152899

               **********************************************************
          DAY *      TEMPERATURE      *          TOTAL        * T Z H * SNOW *
              *    MAX    MIN    MEAN *     RAIN  SNOW    PCP * H R A * GND  *
               **********************************************************
            1 *   11.0   -1.0     5.0 *      6.3              6.3 *       *   0  *
            2 *    9.0    1.0     5.0 *      6.0              6.0 *       *   0  *
            3 *   14.5    2.0     8.3 *                        *       *   0  *
            4 *   13.0    -.5     6.3 *       .2               .2 *       *   0  *
            5 *   10.5    2.5     6.5 *                        *       *   0  *
            6 *   11.0    0.0     5.5 *      5.0              5.0 *       *   0  *
            7 *   10.0    3.0     6.5 *     16.5             16.5 *       *   0  *
            8 *   10.0    2.0     6.0 *                        *       *   0  *
            9 *   12.0   -2.5     4.8 *                        *       *   0  *
           10 *   14.0    0.0     7.0 *                        *       *   0  *
           11 *   20.0   -3.0     8.5 *                        *       *   0  *
           12 *   18.0    4.0    11.0 *      T                T  *       *   0  *
           13 *   14.0    5.0     9.5 *      T                T  *       *   0  *
           14 *   13.5   -1.5     6.0 *      1.3              1.3 *       *   0  *
           15 *   17.0    1.5     9.3 *                        *       *   0  *
           16 *   15.5     .5     8.0 *                        *       *   0  *
           17 *   21.5   -1.0    10.3 *                        *       *   0  *
           18 *   24.5   -2.0    11.3 *                        *       *   0  *
           19 *   25.5    1.0    13.3 *                        *       *   0  *
           20 *   14.0    2.0     8.0 *       .5               .5 * X   X *   0  *
           21 *   16.0    1.0     8.5 *                        *       *   0  *
           22 *   16.5    5.5    11.0 *                        *       *   0  *
           23 *   16.0   -4.5     5.8 *                        *       *   0  *
           24 *   11.0   -4.5     3.3 *                        *       *   0  *
           25 *   16.5    1.0     8.8 *                        *       *   0  *
           26 *   19.5   -3.5     8.0 *                        *       *   0  *
           27 *   23.0   -1.0    11.0 *       .2               .2 *       *   0  *
           28 *   24.5    1.5    13.0 *       .6               .6 *       *   0  *
           29 *   22.0    0.0    11.0 *                        *       *   0  *
           30 *   24.0     .5    12.3 *                        *       *   0  *
               **********************************************************

         TOTAL   487.5    9.0         *     36.6   0.0   36.6 * 1 0 1 *
         MEAN     16.3     .3     8.3

MONTHLY MAXIMUM TEMPERATURE WAS   25.5 ON DAY  19
MONTHLY MINIMUM TEMPERATURE WAS   -4.5 ON DAY  23  24
HIGHEST RAINFALL WAS  16.5 ON DAY   7
NUMBER OF DAYS WITH MEASUREABLE PRECIPITATION IS  9

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS 291.2

LIST OF CODES USED IS AVAILABLE ON REQUEST
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WEATHER RECORD

EVENT: 12
STATION : CLODE CREEK
MONTH : JULY
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2	8		8
3	5.4		5.4
4	5.8		5.8
5	3.8		3.8
6	0.4		0.4
7			0
8	1.2		1.2
9	0.4		0.4
10	0.4		0.4
11			0
12			0
13	12.2		12.2
14	3.8		3.8
15	0.4		0.4
16	16		16
17	2.6		2.6
18			0
19			0
20			0
21	2.8		2.8
22	2.8		2.8
23	2.6		2.6
24	1.6		1.6
25			0
26			0
27	19.4		19.4
28	3.2		3.2
29			0
30			0
31			0
TOTAL :	92.8	0	92.8

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH12.wk2

WEATHER RECORD

EVENT: 12
STATION : CLODE CREEK
MONTH : AUGUST
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4	3.2		3.2
5	3.8		3.8
6			0
7			0
8			0
9			0
10	8.6		8.6
11	0.2		0.2
12			0
13			0
14			0
15			0
16			0
17			0
18			0
19	1.2		1.2
20			0
21			0
22			0
23			0
24			0
25	1.2		1.2
26			0
27			0
28			0
29			0
30			0
31			0
TOTAL :	18.2	0	18.2

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH12A.wk2

WEATHER RECORD

EVENT: 13
STATION : FORDING RIVER
MONTH : NOV
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5		10	10
6		3	3
7		1	1
8			0
9			0
10		2	2
11			0
12			0
13		2	2
14		10	10
15		8	8
16		1	1
17		10	10
18		5	5
19		5	5
20			0
21			0
22			0
23		45	45
24			0
25			0
26		10	10
27		2	2
28		4	4
29		4	4
30			0
31		5	5
TOTAL :	0	127	127

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH13.wk2

WEATHER RECORD

EVENT: 13, 14
STATION : FORDING RIVER
MONTH : OCT
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1	2.6	1	3.6
2			0
3	1.1		1.1
4			0
5			0
6			0
7	1		1
8			0
9			0
10		0.4	0.4
11			0
12			0
13			0
14			0
15			0
16			0
17			0
18			0
19			0
20			0
21			0
22			0
23			0
24			0
25			0
26	11.8		11.8
27	2.8		2.8
28			0
29		13	13
30		19	19
31			0
TOTAL :	19.3	33.4	52.7

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH14A.wk2

WEATHER RECORD

EVENT: 14
STATION : FORDING RIVER
MONTH : SEPT
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1	0.4		0.4
2	2.6		2.6
3			0
4	10.8		10.8
5	0.4		0.4
6			0
7			0
8	8.2		8.2
9	1		1
10	2.4	1	3.4
11	1.8	1.2	3
12	5		5
13			0
14			0
15			0
16			0
17			0
18			0
19			0
20			0
21			0
22			0
23	1.4		1.4
24	2.4		2.4
25	19.4	3	22.4
26	2.6		2.6
27	1		1
28			0
29	0.4		0.4
30	6.4		6.4
31			0
TOTAL :	66.2	5.2	71.4

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH14.wk2

WEATHER RECORD

EVENT: 14
STATION : CLODE CREEK
MONTH : SEPT
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1	38.6		38.6
2	1		1
3	2.6		2.6
4	4	3	7
5			0
6			0
7	3.6		3.6
8	6		6
9	2.6		2.6
10	1	1	2
11	4.2	6	10.2
12			0
13			0
14			0
15	1		1
16	0.8		0.8
17	2		2
18			0
19	1		1
20			0
21			0
22			0
23			0
24	13.2		13.2
25	2	18	20
26			0
27			0
28			0
29	7.4	8	15.4
30	1.6	6	7.6
31	1.6	6	7.6
TOTAL :	94.2	48	142.2

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH14B.wk2

WEATHER RECORD

EVENT: 14
STATION : CLODE CREEK
MONTH : OCT
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2	1.4	2	3.4
3			0
4			0
5			0
6			0
7			0
8	1		1
9			0
10			0
11			0
12			0
13			0
14			0
15			0
16			0
17			0
18			0
19			0
20			0
21			0
22			0
23			0
24			0
25			0
26			0
27	9.4	1.5	10.9
28			0
29	0.8		0.8
30		15	15
31		23	23
TOTAL :	12.6	41.5	54.1

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH14C.wk2

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FORDING RIVER CLODE CRK        CLIMATE SUMMARY FOR        NOVEMBER   1985
                         B.C. REGIONAL ID :    24800
                         AES HEADQUARTERS ID : 1152898


            ***********************************************************
        DAY *      TEMPERATURE      *          TOTAL         * T Z H * SNOW *
            *    MAX    MIN   MEAN  *    RAIN   SNOW    PCP  * H R A * GND  *
            ***********************************************************
          1 *    2.0   -8.0   -3.0  *            2.3    2.3  *       *  24. *
          2 *    2.0    1.0    1.5  *                        *       *   M  *
          3 *    3.0    1.0    2.0  *     7.0   20.0   27.0  *       *   M  *
          4 *    1.0   -2.0    -.5  *           11.0   11.0  *       *  44. *
          5 *   -6.0   -9.0   -7.5  *            T      T    *       *  55. *
          6 *   -3.0   -8.0   -5.5  *                        *       *   M  *
          7 *   -6.0  -10.0   -8.0  *            1.0    1.0  *       *   M  *
          8 *  -10.0  -12.0  -11.0  *            2.6    2.6  *       *  55. *
          9 *  -20.0  -24.0  -22.0  *                        *       *  50. *
         10 *  -20.0  -28.0  -24.0  *                        *       *   M  *
         11 *    0.0  -27.0  -13.5  *                        *       *  48. *
         12 *     .5  -18.0   -8.8  *    22.0          22.0  *       *   M  *
         13 *    3.0   -5.0   -1.0  *                        *       *  46. *
         14 *   -1.0  -10.0   -5.5  *                        *       *   M  *
         15 *   -1.0   -9.0   -5.0  *           15.0   15.0  *       *   M  *
         16 *   -5.0   -8.0   -6.5  *                        *       *  44. *
         17 *  -20.0  -22.5  -21.3  *                        *       *  43. *
         18 *  -20.0  -26.0  -23.0  *            T      T    *       *   M  *
         19 *  -16.0  -25.0  -20.5  *                        *       *  43. *
         20 *  -19.0  -24.5  -21.8  *                        *       *   M  *
         21 *  -24.0  -30.0  -27.0  *                        *       *   M  *
         22 *  -28.0  -33.5  -30.8  *                        *       *   M  *
         23 *  -26.0  -33.5  -29.8  *                        *       *   M  *
         24 *  -26.0  -28.0  -27.0  *                        *       *   M  *
         25 *  -30.0  -33.5  -31.8  *            T      T    *       *   M  *
         26 *  -28.0  -34.0  -31.0  *                        *       *   M  *
         27 *  -20.0  -30.0  -25.0  *                        *       *   M  *
         28 *  -18.0  -29.0  -23.5  *                        *       *   M  *
         29 *  -22.0  -24.0  -23.0  *                        *       *   M  *
         30 *  -19.0  -25.0  -22.0  *                        *       *   M  *
            ***********************************************************

        TOTAL -376.5-574.5          *    29.0   51.9   80.9  * 0 0 0 *
        MEAN   -12.5 -19.2 -15.9

MONTHLY MAXIMUM TEMPERATURE WAS    3.0 ON DAY   3  13
MONTHLY MINIMUM TEMPERATURE WAS  -34.0 ON DAY  26
HIGHEST RAINFALL WAS  22.0 ON DAY  12
HIGHEST SNOWFALL WAS  20.0 ON DAY   3
MAX TOTAL PRECIP WAS  27.0 ON DAY   3
NUMBER OF DAYS WITH MEASUREABLE PRECIPITATION IS  7
NUMBER OF DAYS WITH MEASUREABLE RAINFALL IS  2
NUMBER OF DAYS WITH MEASUREABLE SNOWFALL IS  6

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS1015.8

LIST OF CODES USED IS AVAILABLE ON REQUEST
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WEATHER RECORD

EVENT: 19, 20
STATION : FORDING RIVER
MONTH : MAY
YEAR: 1972

DAY NO	RAINFALL (INS)	SNOWFALL (INS)	TOTAL PRECIP.
1			0
2			0
3			0
4	0.05		0.05
5			0
6			0
7			0
8			0
9	0.12		0.12
10	0.09		0.09
11			0
12			0
13			0
14			0
15			0
16			0
17	0.26		0.26
18			0
19			0
20			0
21			0
22			0
23			0
24			0
25			0
26			0
27			0
28			0
29			0
30			0
31			0
TOTAL :	0.52	0	0.52

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH19.wk2

19,20,43

FORDING RIVER COMINCO

Mean Monthly and Annual Precipitation and Temperature at Fording Coal Ltd. for 1971 and 1972

	Precipitation (in.)		Temperature					
			1971			1972		
Month	1971	1972	Min.	Max.	Mean	Min.	Max.	Mean
Jan	4.76	8.72	4.7	21.0	12.6	-4.9	14.5	4.8
Feb	1.62	5.16	8.8	31.7	17.2	6.4	27.4	16.9
Mar	1.48	4.83	7.1	32.2	17.4	15.4	38.0	26.7
Apr	3.69	2.61	21.0	45.0	32.0	18.8	39.6	29.2
May	2.91	0.62	31.5	57.7	44.9	30.1	55.1	42.6
June	1.73	2.90	30.7	62.1	50.4	37.5	62.0	49.7
July	1.57	2.93	41.3	70.5	55.8	38.2	64.1	51.1
Aug	0.75	2.87	45.7	78.6	62.2	37.0	72.2	54.6
Sept	2.36	2.24	32.0	55.2	43.6	29.0	49.5	39.3
Oct	3.02	1.94	21.8	42.5	32.1	20.9	44.1	32.5
Nov	1.36	0.52	15.9	31.9	23.9	16.2	32.7	24.5
Dec	7.72	3.69	-4.4	17.3	12.9	0.3	17.6	8.9
Annual	32.97	39.83	21.3	45.5	33.8	20.4	43.1	31.7

Table 1:

Weather Summary for the Year: 1974

Station: Fording Coal Ltd.

1974 Cominco 24, 27

FORDING RIVER - COMINCO Elev. 1702 m

Month	Temperature °F					Precipitation		
	Means			Extremes		Rain	Snow	Total[1]
	Max	Min	Mean	Max	Min			
Jan	19.3	2.0	10.6	40	-34	1.02	46.0	5.62
Feb	29.3	10.4	19.9	36	- 3	nil	23.4	2.34
Mar	31.7	13.6	22.6	45	-12	0.46	22.1	2.67
Apr	45.5	25.5	35.4	62	13	0.22	28.4	3.06
May	47.0	29.0	38.0	61	22	3.52	20.7	5.59
Jun	66.4	39.0	52.7	82	28	1.56	nil	1.56
Jul	69.1	40.1	54.6	84	31	0.60	nil	0.60
Aug	63.4	39.6	51.5	83	28	2.26	nil	2.26
Sep	60.7	33.6	47.1	74	12	1.28	2.0	1.48
Oct	54.2	26.3	40.3	72	8	1.88	0.4	1.92
Nov	32.2	15.5	23.8	49	-2	0.71	24.7	3.18
Dec	26.3	10.9	18.6	36	-12	nil	30.9	3.09

[1] In rainfall equivalents: 10" snow = 1" rain

Mean annual temperature: 34.6"
Mean monthly temperature: January 10.6°F
Mean monthly temperature: July 54.6°F
- Months above 50°F: 3
- Months below 32°F: 5
- Months above 40°F: 5

Frost free days (period): July 13 - August 14: 31 days
Total annual precipitation: 33.4"
Annual snowfall: 198.6"
Seasonal occurrence of ppt:

Wet season	Winter (31.8%)
Wettest month	January (5.62")
Dryest season	Summer (13%)
Dryest month	July (0.60")

1980
Cominco

(35)

STATION: FORDING RIVER - COMINCO (Plant Site)
ELEVATION: 1720 m
TEMPERATURE: °C

	MEANS			EXTREMES		PRECIPITATION		
H	MAX.	MIN.	MEAN	MAX.	MIN.	mm RAIN	cm SNOW	mm TOTAL
JAN.	-11.5	-19	-15	+ 3	-35.5	--	46.1	46.1
FEB.	- 3	-12	- 7.5	+12	-33	--	83.2	83.2
MAR.	- 3	-11	- 7	+ 6	-26.5	--	92.1	92.1
APR.	9	- 1.5	4	20.5	-16.5	4.1	15.4	19.5
MAY	13.4	3.6	8.5	21.5	- 1	127.6	--	127.6
JUNE	14.6	5.4	10	22	- 2	77.0	10.8	87.8
JULY	21	10	15.5	29	5	36.8	--	36.8
AUG.	14.6	6.0	10.3	24.5	1	93.0	--	93.0
SEPT.	13.5	4.0	9.0	25	- 4	66.6	1.8	68.4
OCT.	9	- 2	3.5	25	-10	18.6	21.8	40.4
NOV.	- 1	- 7.5	- 4	12.5	-22.5	5.0	88.8	93.8
DEC.	- 7.5	-13.8	-10.7	10	-30	15.0	140.6	155.6
			TOTAL PRECIPITATION			443.7	500.6	944.3

IN RAINFALL EQUIVALENTS = 1 cm snow - 1 mm rain
FROST FREE DAYS (PERIOD) = 99 days / June 8-Sept. 16/80
MEAN ANNUAL TEMPERATURE = 1°C
MEAN MONTHLY TEMPERATURE = January -15°C
MEAN MONTHLY TEMPERATURE = July +15.5°C
TOTAL PRECIPITATION = 944.3 mm.
TOTAL SNOWFALL = 500.6 cm.
TOTAL RAINFALL = 443.7 mm.
MEAN ANNUAL PRECIPITATION = 78.7 mm./mo.

WET SEASON - WINTER = 284.9 mm.
WET MONTH - DECEMBER = 155.6 mm.
DRY SEASON - FALL = 202.6 mm.
DRY MONTH - APRIL = 19.5 mm.

N.L. MARKUSON
POLLUTION CONTROL TECHNICIAN

WEATHER SUMMARY FOR THE YEAR OF [illegible]

STATION: FORDING RIVER - COMINCO (Plant Site)

36

1982
Cominco

ELEVATION: 1702 m

TEMPERATURE: ^0C

MONTH	MEANS			EXTREMES		PRECIPITATION		
	MAX.	MIN.	MEAN	MAX.	MIN.	mm RAIN	cm SNOW	mm TOTAL
JAN.	-9.9	-17.9	-13.9	1.0	-34.0	---	153.8	153.8
FEB.	-4.0	-11.0	-7.5	2.5	-30.5	3.0	67.8	70.8
MAR.	-2.2	-10.0	-6.1	8.0	-19.5	1.0	61.8	62.8
APR.	2.6	-7.5	-2.5	16.0	-18.0	---	21.1	21.1
MAY	9.2	-1.9	3.7	19.0	-8.5	24.6	30.5	55.1
JUNE	16.3	4.7	10.5	25.0	-3.0	50.0	16.0	66.0
JULY	17.7	6.7	12.2	27.0	0.5	19.1	---	19.1
AUG.	18.1	5.9	12.0	24.0	0.0	37.2	---	37.2
SEPT.	13.0	2.5	7.8	24.0	-4.5	63.3	0.8	64.1
OCT.	7.6	-2.3	2.7	19.0	-8.0	10.3	9.3	19.6
NOV.	-4.7	-11.7	-8.2	2.5	-21.0	---	26.8	26.8
DEC.	-5.1	-11.4	-8.3	1.5	-22.0	3.0	23.1	26.1
			TOTAL PRECIPITATION			211.5	411.0	622.5

IN RAINFALL EQUIVALENTS = 1 cm snow - 1 mm rain
FROST FREE DAYS (PERIOD) = 95 days (June 9 - Sept. 13)
MEAN ANNUAL TEMPERATURE = 0°C
MEAN MONTHLY TEMPERATURE = January = -13.9°C
MEAN MONTHLY TEMPERATURE = July = 12.2°C
TOTAL PRECIPITATION = 622.5 mm
TOTAL SNOWFALL = 411.0 cm
TOTAL RAINFALL = 211.5 mm

WET SEASON - WINTER = 250.7 mm
WET MONTH - JANUARY = 153.8 cm
DRY SEASON - SUMMER = 120.4 mm
DRY MONTH - JULY = 19.1 mm

N.L. MARKUSON
POLLUTION CONTROL TECHNICIAN

36,62

FORDING RIVER AT THE MOUTH - STATION NO. 08NK018

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1982

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1.52B	1.92B	2.22B	1.55E	4.95	15.4	23.0	6.15	3.91	5.08	3.04	2.88E	1
2	1.57B	1.88B	2.15B	1.64E	6.27	17.3	20.8	6.10	3.82	5.01	2.97	2.64A	2
3	1.59B	1.84B	2.03B	1.33E	8.74	18.9	19.3	5.98	3.68	5.02	2.83	2.80E	3
4	1.54B	1.77B	2.01B	1.30E	8.32	20.9	17.8	5.68	4.41	4.93	2.86	3.06E	4
5	1.47B	1.71B	1.98B	1.73E	7.01	23.8	16.2	5.46	4.85	4.77	2.82	2.78B	5
6	1.40B	1.65B	1.90B	1.83E	6.55	26.6	15.0	5.26	4.81	4.60	2.80	2.60B	6
7	1.46B	1.60B	1.85B	1.51E	6.92	25.3	14.3	5.06	4.65	4.47	2.78	2.40B	7
8	1.52B	1.56B	1.81B	1.79E	7.09	22.6	14.0	4.92	4.49	4.37	2.79	2.26B	8
9	1.60B	1.49B	1.91B	1.79E	6.61	22.5	13.5	4.92	4.38	4.22	2.79	2.20B	9
10	1.66B	1.51B	1.82B	1.82E	6.25	26.6	12.7	4.96	4.52	4.35	2.76	2.20B	10
11	1.77B	1.52B	1.89B	2.04E	6.33	32.5	12.2	4.81	4.51	3.96	2.69B	2.20B	11
12	1.85B	1.57B	1.88B	2.18E	7.66	38.4	11.9	4.81	4.44	3.87	2.67B	2.20B	12
13	1.93B	1.70B	1.85B	2.40E	8.95	44.3	11.4	4.97	4.33	3.78	2.64B	2.25B	13
14	1.90B	1.95B	1.85B	2.43E	11.1	46.9	11.3	5.45	4.24	3.68	2.62B	2.32B	14
15	1.82B	2.30B	1.85B	2.44E	15.2	45.8	10.8	5.25	4.15	3.63	2.60B	2.48B	15
16	1.65B	2.90B	1.85B	2.36E	19.5	44.1	9.81	5.00	4.13	3.56	2.72B	2.48B	16
17	1.60B	3.10B	1.84B	2.23E	23.1	41.1	9.02	4.75	4.03	3.59	2.87B	2.44B	17
18	1.42B	2.90B	1.82B	2.23E	26.9	37.6	8.43	4.57	3.98	3.74	2.90B	2.40B	18
19	1.63B	2.65B	1.79B	2.29E	26.2	36.7	8.07	4.43	3.98	3.60	2.90B	2.30B	19
20	1.70B	2.42B	1.78B	2.34E	24.9	37.0	8.22	4.28	4.04	3.50	2.82B	2.20B	20
21	1.65B	3.45B	1.79B	2.22E	30.1	35.6	8.47	4.20	4.10	3.44	2.50B	2.07B	21
22	1.60B	3.29B	1.79B	2.24E	33.2	34.0	8.05	4.15	4.34	3.47	2.20B	2.10B	22
23	1.60B	3.13B	1.76B	2.70E	34.5	32.3	7.63	4.14	4.26	3.62	2.39B	2.04B	23
24	1.62B	3.00B	1.74B	2.92E	34.5	29.8	7.39	4.13	4.21	3.61	2.54B	2.30B	24
25	1.69B	2.65B	1.74B	2.90E	42.3	27.8	6.99	4.01	4.13	3.57	2.60B	2.03B	25
26	1.78B	2.72B	1.77B	2.57E	45.0	25.9	6.74	4.18	4.93	3.52	2.40B	2.10B	26
27	1.87B	2.60B	1.78B	3.10A	35.3	26.8	6.48	4.22	5.53	3.44	2.40B	2.08B	27
28	1.96B	2.48B	1.79B	3.93	27.5	25.9	6.28	4.02	5.61	3.36	2.70B	2.02B	28
29	2.00B		1.80B	4.56	20.5	23.7	6.22	4.01	5.46	3.34	2.82E	1.96B	29
30	1.99B		1.81B	4.56	16.2	23.4	6.10	4.07	5.29	3.24	2.90E	1.92B	30
31	1.95B		1.85B		14.7		6.06	4.01		3.11		2.00B	31
TOTAL	52.69	63.45	57.65	73.15	572.35	909.5	344.07	147.99	133.21	121.15	81.32	71.49	TOTAL
MEAN	1.70	2.27	1.86	2.44	18.5	30.3	11.1	4.77	4.44	3.91	2.71	2.31	MEAN
MAX	2.00	3.45	2.22	4.56	45.0	46.9	23.0	6.15	5.61	5.08	3.04	3.06	MAX
MIN	1.40	1.49	1.74	1.79	4.95	15.4	6.06	4.01	3.68	3.11	2.20	1.92	MIN

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 7.20
MAXIMUM DAILY, 46.9 ON JUN 14
MINIMUM DAILY, 1.40B ON JAN 6
MAXIMUM INSTANTANEOUS,
47.7 AT 06:20 MST ON MAY 26

SUMMARY FOR THE YEAR 1982

TYPE OF GAUGE - RECORDING
LOCATION - LAT 49 53 38 N
LONG 114 52 08 W
DRAINAGE AREA, 619 km²
A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED
NATURAL FLOW

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	4 550	JUL	29 700
FEB	5 480	AUG	12 690
MAR	4 980	SEP	11 500
APR	6 320	OCT	10 500
MAY	49 500	NOV	7 030
JUN	78 600	DEC	6 180

TOTAL DISCHARGE, 227 000 dam³

FORDING RIVER BELOW CLODE CREEK - STATION NO. 08NK021

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1982

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.160B	0.136	0.132	0.138	1.66	4.78	5.15	1.19	0.569	0.828	0.371	0.283	1
2	0.159B	0.129	0.131	0.134	2.34	5.49	4.36	1.17	0.547	0.824	0.331	0.231	2
3	0.159B	0.125B	0.130	0.130B	2.97	6.17	4.27	1.12	0.518	0.816	0.283	0.260	3
4	0.154B	0.121B	0.129	0.126B	2.05	6.91	3.79	1.06	0.751	0.781	0.272	0.250	4
5	0.146B	0.119B	0.128B	0.123B	1.66	7.51	3.28	1.01	0.964	0.753	0.316	0.248	5
6	0.139B	0.117B	0.129	0.126B	1.78	7.11	3.10	0.952	0.890	0.707	0.343	0.243B	6
7	0.133B	0.117B	0.127	0.125B	1.35	6.19	3.17	0.916	0.838	0.675	0.333	0.235B	7
8	0.132B	0.116B	0.128	0.126B	1.95	5.51	3.13	0.889	0.783	0.648	0.298	0.225B	8
9	0.132B	0.120B	0.127	0.136	1.86	5.38	2.39	0.881	0.752	0.611	0.268	0.215B	9
10	0.132B	0.121B	0.125	0.173	1.76	6.08	2.87	0.852	0.768	0.566	0.241	0.210B	10
11	0.133B	0.123B	0.120	0.193	2.16	7.38	2.86	0.853	0.726	0.544	0.224	0.205B	11
12	0.135	0.125B	0.135	0.239	3.10	9.33	2.61	0.834	0.687	0.532	0.216	0.206B	12
13	0.135	0.127B	0.128	0.233	3.12	10.8	2.46	0.873	0.659	0.516	0.204	0.208B	13
14	0.135	0.132B	0.123	0.200	4.22	11.4	2.56	0.946	0.626	0.510	0.199	0.209	14
15	0.135B	0.136B	0.123	0.191	5.46	10.9	2.19	0.902	0.592	0.513	0.198	0.209	15
16	0.134B	0.140B	0.124	0.204	6.26	10.4	1.89	0.847	0.575	0.508	0.202	0.212	16
17	0.133B	0.139	0.121	0.218	6.56	9.38	1.69	0.809	0.580	0.562	0.220	0.214	17
18	0.132B	0.135	0.125	0.216	6.97	8.78	1.66	0.786	0.594	0.563	0.244	0.217	18
19	0.132B	0.134	0.122	0.216	6.47	8.76	1.72	0.749	0.617	0.536	0.277	0.209	19
20	0.140	0.136	0.125	0.247	6.13	8.80	2.09	0.721	0.626	0.517	0.309	0.204	20
21	0.139B	0.136	0.122	0.315	7.16	8.39	2.00	0.706	0.645	0.494	0.300B	0.203	21
22	0.139B	0.132	0.123	0.483	7.56	7.97	1.79	0.693	0.635	0.483	0.290B	0.198	22
23	0.137B	0.135	0.124	0.858	7.56	7.48	1.61	0.672	0.623	0.505	0.275B	0.204	23
24	0.142B	0.123	0.117	1.03	7.67	6.46	1.52	0.639	0.653	0.488	0.260B	0.206	24
25	0.146	0.138	0.127	0.794	9.92	6.40	1.45	0.626	0.605	0.496	0.245B	0.205	25
26	0.142	0.135	0.133	0.903	9.38	5.98	1.42	0.699	0.782	0.485	0.250B	0.192	26
27	0.135	0.135	0.142	1.28	6.95	6.56	1.36	0.668	0.913	0.470	0.254	0.189B	27
28	0.138	0.132	0.145	1.75	5.57	5.89	1.33	0.636	0.910	0.443	0.259	0.185B	28
29	0.133		0.146	1.64	4.65	5.43	1.28	0.637	0.880	0.439	0.262	0.180B	29
30	0.132		0.147	1.41	4.10	5.69	1.30	0.620	0.846	0.427	0.277	0.175B	30
31	0.132		0.139		4.12		1.24	0.595		0.398		0.170B	31
TOTAL	4.303	3.622	3.997	13.969	145.08	223.37	74.18	25.551	21.154	17.638	8.021	6.660	TOTAL
MEAN	0.139	0.129	0.129	0.466	4.68	7.45	2.39	0.824	0.705	0.569	0.267	0.215	MEAN
MAX	0.160	0.140	0.147	1.75	9.92	11.4	5.15	1.19	0.964	0.828	0.371	0.283	MAX
MIN	0.132	0.117	0.117	0.125	1.66	4.78	1.24	0.595	0.518	0.398	0.198	0.170	MIN

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 1.50
MAXIMUM DAILY, 11.4 ON JUN 14
MINIMUM DAILY, 0.117B ON FEB 6
MAXIMUM INSTANTANEOUS,
13.1 AT 00:35 MST ON JUN 14

SUMMARY FOR THE YEAR 1982

TYPE OF GAUGE - RECORDING
LOCATION - LAT 50 12 05 N
LONG 114 52 57 W
DRAINAGE AREA, 104 km²

B - ICE CONDITIONS

NATURAL FLOW

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	372	JUL	6 410
FEB	313	AUG	2 210
MAR	345	SEP	1 830
APR	1 210	OCT	1 520
MAY	12 500	NOV	693
JUN	19 300	DEC	575

TOTAL DISCHARGE, 47 300 dam³

TABLE 7-2

1976

Weather Summary for the Year: 1976

Station: FORDING COAL LTD. (Fording River Station)

Cominco

Elev. 1702m

	Temperature °C					Precipitation		
Month	Means			Extremes		Rain MM	Snow CM	Total MM
	Max	Min	Mean	Max	Min			
Jan	- 3.1	-12.6	- 7.9	8.3	-23.9	----	103.2	103.2
Feb	- 3.2	-11.9	- 7.5	4.4	-22.8	----	69.1	69.1
Mar	- 1.6	-11.8	- 6.7	7.2	-31.6	0.3	20.3	20.6
Apr	7.7	- 3.2	2.3	16.7	-10.0	----	16.5	16.5
May	16.0	- 1.5	7.3	21.1	- 5.0	32.0	----	32.0
Jun*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Jul	18.5	13.0	15.8	26.0	7.0	80.8	----	80.5
Aug	16.0	12.0	14.0	23.0	3.5	303.8	----	303.8
Sep	16.0	10.5	13.3	24.5	5.5	100.7	----	100.7
Oct	8.6	- 3.6	2.5	19.4	-13.9	11.4	9.7	21.1
Nov	0.7	- 8.5	- 3.9	7.8	-21.1	2.8	18.5	21.3
Dec	-1.6	- 8.8	- 5.2	7.8	-13.3	----	24.1	24.1

[1] In rainfall equivalents: 1 cm snow = 1 mm rain

Mean annual temperature:	N/A
Mean monthly temperature: January	-7.9°C
Mean monthly temperature: July	15.8°C
Months above 18°C:	0
Months below 0°C:	5
Months above 6°C:	4
Frost free days (period):	N/A
Total annual precipitation:	N.A
Annual snowfall:	266.4 cm.
Seasonal occurrence of ppt:	
Wet season	Summer
Wettest month	August (303.8 mm)
Dryest season	Winter
Dryest month	April (16.5 mm)

* Due to labour problems data is incomplete.

FLATHEAD RIVER AT FLATHEAD - STATION NO. 08NP001

DAILY DISCHARGE IN CUBIC FEET PER SECOND FOR 1976

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	334 B	242 B	178 B	206	1680	2920	2410	643	626	275	349	233 B	1
2	319 B	242 B	145 B	202	2450	2630	2050	627	589	289	362	190 B	2
3	330 B	239 B	131 B	201	3390	2400	1840	643	571	299	312	150 B	3
4	350 B	195 B	174 B	208	4160	2250	1780	618	562	300	235	153 B	4
5	370 B	150 B	232 B	237	4070	2160	1750	656	535	293	271	170 B	5
6	354 B	189 B	273 B	286	4180	2230	1680	763	528	287	259	178 B	6
7	324 B	258 B	273 B	396	4660	2230	1670	721	526	234	250	183 B	7
8	311 B	288 B	257 B	579	5490	2510	1710	851	515	271	238	150 B	8
9	316 B	315	242 B	955	6450	3310	1650	1890	438	261	233	155 B	9
10	312 B	302	226 B	1370	6820	3730	1510	1600	479	257	218	150 B	10
11	315 B	286 B	209 B	1740	8220	3140	1330	1370	466	253	218	154 B	11
12	308 B	294 B	180 B	2120	5980	3010	1360	1190	467	244	210	142 B	12
13	296 B	302 B	192 B	2390	5290	2820	1520	1070	456	238	201	132 B	13
14	283 B	299 B	192 B	2190	6420	2440	1370	1000	436	233	179	130 B	14
15	283 B	283 B	186 B	1800	5230	2260	1250	936	417	227	189	130 B	15
16	300 B	268 B	194 B	1490	4380	2320	1160	975	406	227	135	137 B	16
17	303 B	257 B	205 B	1260	4560	2500	1110	1110	393	230	206	123 B	17
18	305 B	257 B	223	1140	4200	2590	1080	947	352	223	239	122 B	18
19	290 B	253 B	219	1060	3360	2800	1050	860	378	214	231	105 B	19
20	275 B	253 B	217	1010	4550	2940	1000	1030	363	214	250	92.0 B	20
21	269 B	246 B	209	952	4110	2840	953	1100	350	216	233	83.0 B	21
22	267 B	234 B	203	864	3680	2670	838	990	340	214	221	78.0 B	22
23	281 B	244 B	207	837	3920	2490	824	953	332	211	234	80.0 B	23
24	274 B	245	207	882	4730	2510	786	910	324	208	230	82.0 B	24
25	273 B	242	206	979	4770	2330	760	864	326	211	232	84.0 B	25
26	268 B	231	202	949	3900	2150	738	933	331	206	138	86.0 B	26
27	278 B	226	200	930	3320	1900	709	880	328	206	140 B	86.0 B	27
28	273 B	191	198	882	4430	1830	679	739	294	202	170 B	85.0 B	28
29	263 B	211	193	909	4220	1910	651	737	282	202	200 B	82.0 B	29
30	268 B		190	1140	3410	2270	659	686	274	205	268 B	79.0 B	30
31	256 B		195		3200		662	649		218		76.0 B	31
TOTAL	9245	7242	6354	30184	139680	76070	38669	29051	12789	7418	7141	3902.0	TOTAL
MEAN	298	250	205	1010	4510	2540	1250	937	426	239	238	126	MEAN
AC-FT	18300	14400	12600	59900	277000	151000	76700	57600	25400	14700	14200	7740	AC-FT
MAX	370	315	273	2390	8220	3730	2410	1890	626	300	362	230	MAX
MIN	256	150	131	201	1680	1830	651	618	274	202	140	76.0	MIN

SUMMARY FOR THE YEAR 1976

MEAN DISCHARGE, 1000 CFS
TOTAL DISCHARGE, 730000 AC-FT
MAXIMUM DAILY DISCHARGE, 8220 CFS ON MAY 11
MINIMUM DAILY DISCHARGE, 76.0 CFS ON DEC 31

MAXIMUM INSTANTANEOUS DISCHARGE
8800 CFS AT 1230 MST ON MAY 11

INTERNATIONAL GAUGING STATION

TYPE OF GAUGE - RECORDING
LOCATION - LAT 49 00 02 N
LONG 114 28 35 W
DRAINAGE AREA 427 SQ MILES

B-ICE CONDITIONS

NATURAL FLOW

(38)

FORDING RIVER AT THE MOUTH - STATION NO. 08NK018

DAILY DISCHARGE IN CUBIC FEET PER SECOND FOR 1976

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	102 B	89.0 E	67.0 B	83.4 A	220	812	908	305	305	182 E	118 E	89.4 E	1
2	103 B	86.0 E	68.0 B	87.0 E	330	727	765	339	295	170 E	119 E	83.8 E	2
3	105 B	74.9 A	68.0 B	91.0 E	527	673	650	306	289	155 A	115 E	92.5 E	3
4	110 B	77.5 E	68.0 B	95.0 E	730	628	625	293	278	150 E	114 E	94.2 E	4
5	102 B	80.0 E	69.0 B	105 E	864	586	630	973	265	148 E	113 E	91.5 E	5
6	96.0 B	82.0 E	70.0 B	130 E	887	561	598	2020	267	144 E	114 E	83.8 A	6
7	97.0 B	82.0 E	70.0 B	150 E	939	548	601	1200	266	142 E	112 E	85.7 E	7
8	102 B	82.0 E	69.0 B	175 E	1240	588	605	1120	279	138 E	107 A	93.0 A	8
9	108 B	82.6 A	69.0 B	208 E	1480	737	568	1210	272	137 E	107	91.5 E	9
10	106 B	82.6 E	69.5 B	248 E	1630	862	533	1060	274	136 E	104	83.8 E	10
11	108 B	83.5 E	67.5 B	290 E	1910	813	435	930	283	134 E	99.2	83.1 E	11
12	107 B	83.5 E	67.5 B	365 E	1490	793	514	767	318	132 A	97.5	85.7 E	12
13	101 B	83.5 E	67.5 B	440	1320	757	527	663	337	130 E	97.2	86.0 E	13
14	100 B	83.5 E	65.5 B	430	1620	662	509	602	322	127 E	97.7	82.3 E	14
15	104 B	84.0 E	65.5 B	374	1410	623	460	611	302	124 E	98.1	83.0 E	15
16	106 B	83.5 E	65.0 B	339	1260	633	435	645	285	123 E	99.8	92.5 E	16
17	108 B	82.6 A	65.9 B	301	1280	652	433	685	273	118 E	117	98.3 E	17
18	123 B	81.0 E	66.0 B	273	1170	685	433	621	267 A	117 E	104	96.6 E	18
19	120 B	80.0 E	67.0 B	251	1090	820	421	574	257 E	114 A	97.2	96.2 E	19
20	112 B	79.0 E	69.0 B	236	1210	902	339	550	250 E	113 E	95.2	96.2 E	20
21	105 B	77.5 E	71.0 B	222	1110	858	337	503	240 E	112 E	90.4	88.4 E	21
22	103 B	77.5 E	75.0 B	212	1000	766	368	462	232 E	111 E	90.6	79.9 E	22
23	104 B	78.0 E	77.0 B	203	1030	771	347	436	223 E	110 E	90.6	82.5 E	23
24	95.0 B	78.0 E	77.0 B	199	1200	750	337	416	216 E	110 E	99.2	88.4 E	24
25	88.0 B	74.9 A	78.0 B	201	1230	698	323	408	207 E	110 E	97.4	84.3 E	25
26	89.0 B	74.0 E	78.0 E	191	1070	623	320	399	200 E	114 A	93.7	83.7 E	26
27	83.8 A	71.0 E	79.0 E	185	992	563	313	382	198 E	114 E	93.5	85.3 E	27
28	90.5 E	66.0 B	79.5 E	179	1270	561	295	363	192 E	115 E	90.0 B	75.8 E	28
29	90.5 E	66.0 B	80.5 E	171	1200	626	285	347	191 E	116 E	85.1 B	69.4 E	29
30	90.0 E		82.0 E	178	1030	790	297	333	183 E	117 E	82.6 B	63.0 B	30
31	90.0 E		82.6 A		919		307	319		118 E		58.2 B	31
TOTAL	3156.8	2305.6	2212.5	6612.4	34658	21074	14694	19762	7784	3981	3038.0	2673.1	TOTAL
MEAN	102	79.5	71.4	220	1120	702	474	637	259	128	101	85.2	MEAN
AC-FT	6260	4570	4390	13100	68700	41800	29100	39200	15400	7900	6030	5300	AC-FT
MAX	123	89.0	82.6	440	1910	902	908	2020	337	182	119	98.3	MAX
MIN	88.0	66.0	65.0	83.4	220	548	285	293	183	110	82.6	58.2	MIN

SUMMARY FOR THE YEAR 1976

MEAN DISCHARGE, 333 CFS
TOTAL DISCHARGE, 242000 AC-FT
MAXIMUM DAILY DISCHARGE, 2020 CFS ON AUG 6
MINIMUM DAILY DISCHARGE, 58.2 CFS ON DEC 31

MAXIMUM INSTANTANEOUS DISCHARGE
2380 CFS AT 0830 MST ON AUG 6

TYPE OF GAUGE - RECORDING
LOCATION - LAT 49 53 38 N
LONG 114 52 03 W
DRAINAGE AREA 233 SQ MILES

A-MANUAL GAUGE
B-ICE CONDITIONS
E-ESTIMATED

NATURAL FLOW

44

CLIMATOLOGICAL STATION REPORT

STATION FORDING RIVER COMINCO

Prov. B. C.

Time of Observation 8:00 a.m. 8:00 p.m.

Observer R.O. Miller

Month May 1973

Day of Month	Time of Observation	Temperature (°F) Maximum Observed	Maximum For Day	Minimum Observed	Minimum For Day	After Reset	Grass Minimum	Precipitation (inches) Rain Observed	Rain For Day	Snow Observed	Snow For Day	Total For Day	Times of Precipitation (Calendar day) Began	Ended	Depth of Snow on Ground	Weather (Calendar day) Thunderstorm	Freezing Rain	Hail	Remarks
1	a.m.			35		37													
	p.m.	47	47	38	15	45													
2	a.m.	45		22		34													
	p.m.	55	55	34	22	49													
3	a.m.	49		29		38													
	p.m.	53	53	38	29	51													
4	a.m.	52		28		43													
	p.m.	54	54	43	28	43													
5	a.m.	46		30		37													
	p.m.	58	58	37	30	51													
6	a.m.	56		29		36													
	p.m.	53	53	36	29	48													
7	a.m.	49		29		29													
	p.m.	51	51	[illegible]	28	43													
8	a.m.	43		32		34						0.5 snow							
	p.m.	44	44	33	32	42				0.5									
9	a.m.	42		30		31													
	p.m.	42	42	31	30	40													
10	a.m.	41		24		25													
	p.m.	40	40	25	24	35													
11	a.m.	39		20		22													
	p.m.	50	50	22	20	48													
12	a.m.	48		24		26													
	p.m.	62	62	25	24	62													
13	a.m.	62		29		31													
	p.m.	68	68	30	29	67													
14	a.m.	68		30		39													
	p.m.	75	76	38	30	76													
15	a.m.	76		34		37													
	p.m.	78	78	37	34	77													
16	a.m.	77		39		43													
	p.m.	74	74	43	39	70													
17	a.m.	70		37		38													
	p.m.	73	73	37	37	72													
18	a.m.	72		39		43													
	p.m.	64	64	43	39	62													
19	a.m.	63		35		36													
	p.m.	63	63	36	35	58													
20	a.m.	60		40		40													
	p.m.	43	43	35	35	39													
21	a.m.	40		30		30													
	p.m.	54	54	30	30	52													
22	a.m.	32		28		30													
	p.m.	64	64	30	28	58													
23	a.m.	57		33		34													
	p.m.	62	62	34	33	58													
24	a.m.	58		40		44													
	p.m.	58	58	44	40	40			.25			.25							142.5
25	a.m.	50	52	42		42		.25											15.7
	p.m.	41	42	33	33	33				4.0	18.0	1.50							157
26	a.m.	33		31		31				11.0									
	p.m.	37	37	31	31	34													
27	a.m.	35		32		34													
	p.m.	45	45	34	32	44													
28	a.m.	45		30		34				T	T	T							
	p.m.	53	53	34	30	51													
29	a.m.	52		30		42													
	p.m.	66	66	40	30	40													
30	a.m.	63		34		40													
	p.m.	70	70	40	34	54													
31	a.m.	65		37		40													
	p.m.	59	59	40	37	57													
1	a.m.	57																	
SUMS			1758		937				.25		15.50	1.00							
MEANS			56.7		30.2														

Nº of Days with

TEMPERATURE EXTREMES

Highest 78 Date May 15

Lowest 15 Date May 1

TEMPERATURE

Mean Max. 56.7

Mean Min. 30.2

Mean 43.5

Table 2:

1973 Cominco ⑷④

Weather Summary for the Year: 1973

Station: Fording Coal Ltd. — Fording River - Cominco Elev. 1702m

Month	Temperature °F					Precipitation			
	Means			Extremes		Rain	Snow	Total[1]	
	Max	Min	Mean	Max	Min				
Jan	22.9	2.8	18.8	42	-30	-	21.8	2.18	5.27
Feb	31.7	5.2	18.4	48	-20	-	11.2	1.12	
Mar	36.6	16.1	26.3	47	4	-	19.7	1.97	
Apr	41.5	22.4	31.9	55	2	.08	7.7	0.85	5.71
May	56.7	30.2	43.5	78	15	.25	15.5	1.80	
Jun	60.4	37.8	49.1	83	28	2.16	9.0	3.06	
Jul	71.6	40.8	56.2	84	28	1.14	-	1.14	5.21
Aug	70.5	40.0	55.2	85	29	3.36	-	3.36	
Sep	58.8	35.7	47.2	79	21	.71	T	0.71	
Oct	43.9	28.9	36.4	58	15	.65	7.8	1.43	8.46
Nov	25.5	11.1	18.3	42	-13	.75	30.2	3.77	
Dec	25.2	10.1	17.6	38	-18	.31	29.5	3.26	

[1] In rainfall equivalents: 10" snow = 1" rain

Mean annual temperature: 34.9°F
Mean monthly temperature: January 18.8°F
Mean monthly temperature: July 56.2°F
Months above 50°F: 2
Months below 32°F: 6
Months above 40°F: 5
Frost free days (period): July 11 - August 18 - 37 days
Total annual precipitation: 24.65"
Annual snowfall: 152.4"
Seasonal occurrence of ppt:
Wet season Fall - 34%
Wettest month November 3.77"
Dryest season Summer - 21%
Dryest month September 0.71"

Environment

Time of observation 8 a.m. 4 p.m.

Observer S. Hilts

T ☐
P ☐

STATION — 2089h 1162427-267 EC
PROVINCE DENISON PLANT SITE

MONTH MAY 1 1986

48, 49

TIME OF OBSERVATION	TEMPERATURE (°C) Maximum Observed	Maximum For Day	Minimum Observed	Minimum For Day	AFTER RESET	PRECIPITATION Rain Measured mm	Rain For Day mm	Snow Measured cm	Snow For Day cm	Total For Day mm	TIMES OF PRECIPITATION (Calendar Day) Began	Ended	Depth of Snow on Ground whole cm	Weather (Calendar Day) Thunderstorm	Freezing Rain	Hail	REMARKS
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
a.m.			-7.0		-5.0												
p.m.	0.0	0.0	-3.0	-7.0	0.0								0				Cloudy, Flurries
a.m.	+0.5		-1.5		-0.5												
p.m.	+12.0	+12.0	-0.5	-1.5	+12.0								0				
a.m.	2.0		0.0		0.5						0400	0500					Weekend Snow- No Depth
p.m.	11.0	11.0	0.5	0.0	10.0					3.8							Measurement
a.m.	10.0		-1.0		3.5												
p.m.	12.0	12.0	3.5	-1.0	11.5												
a.m.	11.5		+1.0		5.0												
p.m.	12.0	12.0	5.0	+1.0	10.0								0				
a.m.	10.0		-1.0		3.0												
p.m.	13.5	13.5	3.0	-1.0	13.0												
a.m.	13.0		+2.5		7.0												
p.m.	12.0	13.0	7.0	2.5	11.5												
a.m.	11.5		3.5		7.0												Sunny
p.m.	11.5	11.5	7.0	3.5	11.5												
a.m.	11.5		0.5		4.5												Sunny
p.m.	10.0	11.5	7.0	0.5	9.5												
a.m.	9.5		-2.5		5.0												
p.m.	11.5	11.5	5.0	-2.5	11.0												
a.m.	11.0		-2.0		5.0												
p.m.	10.5	11.0	5.0	-2.0	9.5								0				
a.m.	9.5		2.0		5.5												Cloudy, Evening Showers
p.m.	10.0	10.0	5.5	2.0	9.5						1830	2000	0				
a.m.	9.5		-0.5		2.0	2.0											
p.m.	4.5	9.5	2.0	-0.5	3.0		2.0			2.0			0				Cloudy, Few Flurries
a.m.	3.0		-1.0		-0.5			2.0			0000	0800					
p.m.	3.5	3.5	0.5	-1.0	3.5								2				
a.m.	3.5		-1.0		0.5												Sunny A.M.
p.m.	9.5	9.5	0.5	-1.0	9.5								0				Few Flurries P.M.
a.m.	9.5		-3.0		-2.5												
p.m.	14.0	14.0	-2.5	-3.0	12.0								0				Sunny
a.m.	12.0		5.5		8.5												Mostly Sunny
p.m.	13.5	13.5	8.5	5.5	13.0						1900	2000					
a.m.	13.0		6.5		7.5	0.8											Mostly Sunny
p.m.	9.5	13.0	7.5	6.5	9.5		0.8			0.8							
a.m.	11.0		6.0		7.0												
p.m.	16.0	16.0	7.0	6.0	16.0	1.4	1.4			1.4	1300	1400					Sunny, Afternoon Cloud
a.m.	17.5		7.0		9.5												
p.m.	10.0	17.5	9.5	7.0	9.5												Sunny, Cloudy Periods
a.m.	12.5		-0.5		2.5												Cloudy
p.m.	10.0	12.5	2.5	-0.5	9.5												
a.m.	9.5		3.0		5.5												
p.m.	11.0	11.0	6.0	3.0	6.0												
a.m.	6.0		-1.0		6.0												Sunny
p.m.	13.0	13.0	6.0	-1.0	11.5												
a.m.	11.5		2.0		5.0												Sunny
p.m.	17.0	17.0	5.0	2.0	16.5												
a.m.	17.5		9.5		13.5												Mostly Cloudy
p.m.	21.5	21.5	13.5	9.5	21.5												
a.m.	22.0		7.0		18.0												
p.m.	24.0	24.0	12.0	7.0	20.0												
a.m.	20.0		+5.0		11.0												
p.m.	20.0	20.0	4.0	4.0	19.0												Sunny & Clear
a.m.	10.0		4.0		10.0												
p.m.	24.0	24.0	10	4.0	23.5												S[illegible] & Clear
a.m.	11.5		4.0		11.0												
p.m.	26.0	26.0	12.0	4.0	26.0												Sunny & Clear
a.m.	19.0		7.0		17.5												
p.m.	23.0	23.0	10.0	7.0	22.5												Sunny & Clear
a.m.	23.0		5.5		12.0												
p.m.	25.0	25.0	13	5.5	24.5												Sunny & Clear
a.m.	18.0										Total no. of days with			0	0	0	
SUMS		432.5		58.5			4.2		6.2	10.4							
MEANS		14.0		1.9													

TEMPERATURE EXTREMES

Maximum. 26 Date. 29TH

Minimum. -7 Date. 1ST

TEMPERATURE

Mean Max. 19

Mean Min 1.9

Mean. 8.0

Atmospheric Environment Environnement atmosphérique

CLIMATOLOGICAL STATION REPORT

STATION – 20898 1182427-267 BC –
PROVINCE DENISON PLANT SITE

ne of observation 8 a.m. 4 p.m.

T ☐
P ☐

server S Hilts

MONTH June 1986

48,49

TIME OF OBSERVATION	TEMPERATURE (°C) Maximum Observed	Maximum For Day	Minimum Observed	Minimum For Day	AFTER RESET	PRECIPITATION Rain Measured mm	Rain For Day mm	Snow Measured cm	Snow For Day cm	Total For Day mm	TIMES OF PRECIPITATION (Calendar Day) Began	Ended	Depth of Snow on Ground whole cm	Weather (Calendar Day) Thunderstorm	Freezing Rain	Hail	REMARKS
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
a.m.			10.0		17.0												Sunny
p.m.	19.5	19.5	12.0	10.0	19.0												
a.m.	10.5		8.5		10.5												Sunny
p.m.	16.5	17.0	10.0	8.5	17												
a.m.	17.0		10.5		12.0												Sunny
p.m.	18.0	18.0	12.0	10.5	18.0												
a.m.	19.0		4.0		8.0												
p.m.	20.0	20.0	8.0	4.0	19.0												
a.m.	19.0		4.5		10.5												
p.m.	23.5	23.5	10.5	4.5	23.0												
a.m.	24.0		7.0		11.5												
p.m.	22.5	24.0	10.0	7.0	22.5												
a.m.	23.5		7.0		10.5												
p.m.	19.5	23.5	11.0	7.0	17.5												
a.m.	18.0		10.5		11.0												
p.m.	16.5	18.0	11.0	10.5	16.5												
a.m.	17.0		10.0		13.5												
p.m.	16.0	17.0	13.5	10.0	16.0												
a.m.	16.0		8.0		12.0												
p.m.	16.5	16.0	12.0	8.0	14.5												
a.m.	14.5		5.0		8.0												
p.m.	14.0	14.5	8.0	5.0	13.0	2.1	2.1			2.1	1715	1725					
a.m.	13.0		1.0		4.0												
p.m.	18.0	18.0	4.0	1.0	18.0												
a.m.	18.5		4.0		7.0												
p.m.	19.0	19.0	7.0	4.0	19.0	0.4	0.4			0.4	2015	2050					
a.m.	19.5		6.0		10.0								–				Sunny
p.m.	19.5	19.5	10.0	6.0	19.5												
a.m.	19.5		7.0		7.0	16.6					0000	0800					Cloudy
p.m.	7.0	19.5	5.0	5.0	5.5	15.6	32.2			32.2	0800	1600					
a.m.	7.0		3.0		4.0	2.0					1510	1580					
p.m.	15.5	15.5	4.0	3.0	14.0	3.2	5.2			5.2	1800	2245		✓		✓	
a.m.	14.0		3.5		6.5												
p.m.	17.0	17.0	6.5	3.5	17.0												
a.m.	17.5		3.5		6.5	0.2					0730	0745					
p.m.	17.0	17.5	6.5	3.5	17.0		0.2										
a.m.	17.5		6.5		9.0												Strong SW Winds, Clear
p.m.	12.5	17.5	9.0	9.0	12.5												
a.m.	12.5		8.0		10.0												Strong SW Winds, Clear
p.m.	17.0	17.0	10.0	8.0	17.0												
a.m.	17.0		10.0		12.5												
p.m.	16.5	17.0	12.5	10.0	13.5												
a.m.	14.5		11.0		14.5												
p.m.	18.5	19.5	14.5	11.0	18.0	7.6	7.6			7.6	1900	2000					
a.m.	19.0		11.0		12.5												Clear, Windy
p.m.	17.5	19.0	12.5	11.0	17.5												
a.m.	18.0		7.0		11.0												Mostly Sunny, Moderate SW Wind
p.m.	17.0	18.0	11.0	7.0	17.0												
a.m.	17.0		7.0		9.0												Mostly Sunny
p.m.	16.0	17.0	9.0	7.0	16.0												
a.m.	16.0		6.0		11.5												Mostly Sunny
p.m.	19.0	19.0	11.5	6.0	19.0												
a.m.	20.0		5.0		10.5												
p.m.	21.0	21.0	10.5	5.0	21.0												
a.m.	21.5		7.0		10.0												
p.m.	23.5	23.5	10.0	7.0	23.0												
a.m.	24.5		9.0		13.0												
p.m.	24.5	24.5	13.0	9.0	24.0												
a.m.	24.5		13.5		14.5												Cloudy, Sunny Breaks
p.m.	22.5	22.5	14.5	13.5	22.5									✓			
a.m.	22.5																
p.m.																	
a.m.											Total no. of days with						
SUMS		574.5		214.5			47.5			47.5							
MEANS		19.2		7.2													

TEMPERATURE EXTREMES
Maximum 24.5 Date 29, 30
Minimum 1.0 Date 12

TEMPERATURE
Mean Max. 19.2
Mean Min 7.2
Mean 13.1

STATION Plantsite
PROVINCE BC.
MONTH August 1985

e of observation 8 a.m. 4 p.m.

T ☑
P ☑

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(54)

TIME OF OBSERVATION	TEMPERATURE (°C)					PRECIPITATION					TIMES OF PRECIPITATION (Calendar Day)		Depth of Snow on Ground	Weather (Calendar Day)			REMARKS
	Maximum		Minimum			Rain		Snow		Total For Day							
2	Observed	4 For Day	5 Observed	6 For Day	7 AFTER RESET	8 Measured mm	9 For Day mm	10 Measured cm	11 For Day cm	12 mm	13 Began	14 Ended	15 whole cm	16 Thunderstorm	17 Freezing Rain	18 Hail	19
a.m.			15		21												sunny /clouds
p.m.	30	33	17	15													
a.m.	33		17		19												overcast
p.m.	22		18		19												
a.m.																	sunny /clouds / rain
p.m.		25		16			1.9										
a.m.																	sunny /clouds
p.m.		20		12													
a.m.																	sunny / clouds
p.m.		22		11													
a.m.	24		5		11												sunny / clouds
p.m.	21	21	9	5	21		10.2										
a.m.	21		10		10												overcast / rain,
p.m.	10	10	10	10	10		23.5										
a.m.	10		7		10												fog/sun /clouds / rain
p.m.	20	20	10	7	20		2.1										
a.m.	20		10		11												overcast
p.m.	15	15	11	10	15												
a.m.																	sunny /clouds
p.m.																	
a.m.																	clouds / rain
p.m.							5.8										
a.m.	16		8		15												clouds / sun
p.m.	15	18	17	8	11												
a.m.	18		3		8												clouds/sun
p.m.	21	21	8	3	20												
a.m.	21		14		15												overcast / rain
p.m.	17	17	10	10	10		20										
a.m.	8		6		6												overcast / rain
p.m.	12	12	6		12		1.0										
a.m.	12		1		6												sunny /clouds
p.m.	22	22	6	1	22												
a.m.																	sunny /clear
p.m.		22		10													
a.m.																	sun / clouds
p.m.		23		11			0.5										
a.m.	19		5		9												overcast
p.m.	17		9		16												
a.m.	16		5		6												sunny /clouds
p.m.	17		7		17												
a.m.	18		3		11												sunny / clouds
p.m.	19		7		19												
a.m.	19		9		15												sunny / clouds
p.m.	19		5		19												
a.m.	20		10		15												sunny / clouds
p.m.	19		5		19												
a.m.																	sunny / clouds
p.m.																	
a.m.																	sunny/clouds/rain
p.m.							.5										
a.m.	21		0		4												sunny / clouds
p.m.	20	20	5	0	20												
a.m.	19		6		7												sunny/clouds
p.m.	18	19	7	6	18												
a.m.	19		4		6												sunny/ clouds
p.m.	21	21	8	4	21												
a.m.	20		5		10												sunny / clouds/rain
p.m.	22	22	10	5	22												
a.m.	20		5		10												fog
p.m.																	
a.m.																	
p.m.							10.4										
a.m.											Total no. of days with						
MS		383		144			75.9										
EANS		20.2		8													

TEMPERATURE EXTREMES
Maximum 33°C Date 1
Minimum 4 Date 26

TEMPERATURE
Mean Max. [illegible]
Mean Min 5
Mean [illegible]

STATION

of observation 8 a.m. 4 p.m.

T ☐
P ☐

PROVINCE B.C PLANTSITE

erver

MONTH SEPT 19 85

54

TIME OF OBSERVATION	TEMPERATURE (°C) Maximum Observed 3	Maximum For Day 4	Minimum Observed 5	Minimum For Day 6	AFTER RESET 7	PRECIPITATION Rain Measured 8 mm	Rain For Day 9 mm	Snow Measured 10 cm	Snow For Day 11 cm	Total For Day 12 mm	TIMES OF PRECIPITATION (Calendar Day) Began 13	Ended 14	Depth of Snow on Ground whole cm 15	Weather (Calendar Day) Thunderstorm 16	Freezing Rain 17	Hail 18	REMARKS 19
a.m.																	SUNNY / CLOUDY
p.m.																	
a.m.																	SUNNY / CLOUDY
p.m.																	
a.m.																	CLOUDY, WINDY, A TAD CHILLY
p.m.	14						1.4			1.4							
a.m.							1.4										FOG, CLOUDY WINDY
p.m.	8						15			15							
a.m.																	RAIN / SNOW (NASTY)
p.m.	0						3.2		2	5.2							
a.m.																	SNOW / RAIN.
p.m.	0						8.4			8.4							
a.m.																	CLOUDY
p.m.																	
a.m.																	SUNNY, WARM.
p.m.																	
a.m.	20		1		1												SUNNY.
p.m.	20	20	1	1	20												
a.m.	20		-2		-2												CLEAR
p.m.	21	21	-2	-2	21		0.5			0.5							
a.m.	21		2		4												[illegible]
p.m.	21	21	2	2	17												
a.m.	17		10		10												CLOUD/FOG/RAIN
p.m.	11	11	10	10	10		25.1			25.1							
a.m.	11		9		9												CLOUD/FOG/RAIN
p.m.	11	11	9	9	11												
a.m.																	CLOUDY
p.m.																	
a.m.																	CLOUD
p.m.							4.2			4.2							
a.m.	11		7		9												CLOUDY
p.m.	10	10	6	6	6		17.6			17.6							
a.m.	2		2		2												[illegible]
p.m.	4	4	1	1	3		0.4		1.5	1.9			2				
a.m.	3		-1		-1												CLOUDY / SNOW
p.m.	1	2	-1	-1	1		2			2			0				
a.m.	2		-2		-2												SUNNY !!
p.m.	8	8	-2	-2	8		1			1							
a.m.	8		7		7												
p.m.	12	12	7	7	11												
a.m.																	CLOUDY
p.m.																	
a.m.																	SUNNY
p.m.							16			16							
a.m.	13		-3		4												CLOUDY, SOME SUN
p.m.	10	10	4	-3	10		1			1							
a.m.	10		5		5												CLEAR.
p.m.	14	14	5	5	13												
a.m.	13		9		11												HIGH, THIN, CLOUD
p.m.	17	17	11	9	14		5.4			5.4							
a.m.	17		4		5												OVERCAST, RAIN
p.m.	5	5	2	2	3		0.2			0.2							
a.m.	3		-3		-3												CLEAR
p.m.	9	9	-3	-3	7												
a.m.																	CLEAR
p.m.																	
a.m.																	CLEAR
p.m.																	
a.m.	17		-3		7												HIGH, THIN OVERCAST
p.m.	12	12	7	-3	9												
a.m.																	
p.m.																	
a.m.	10										Total no. of days with						
MS		187		38			103.4		3.5	106.9							
ANS		11.7		2.4													

TEMPERATURE EXTREMES

Maximum. 21 Date. 10, 11

Minimum. -3 Date. 23, 27, 30

TEMPERATURE

Mean Max. 11.7

Mean Min 2.4

Mean. 7.1

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FORDING RIVER COMINCO         CLIMATE SUMMARY FOR        JULY          1986
                       B.C. REGIONAL ID :    25000
                       AES HEADQUARTERS ID : 1152899

          **********************************************************************
      DAY *      TEMPERATURE       *          TOTAL           * T Z H * SNOW *
          *    MAX    MIN    MEAN  *    RAIN   SNOW     PCP   * H R A * GND  *
          **********************************************************************
        1 *   23.0    1.0    12.0  *    T                 T   *       *   0  *
        2 *   21.5   14.0    17.8  *    8.0             8.0   *       *   0  *
        3 *    9.0    4.0     6.5  *    5.4             5.4   * X     *   0  *
        4 *    9.0    1.0     5.0  *    5.8             5.8   * X     *   0  *
        5 *   11.0    1.0     6.0  *    3.8             3.8   * X     *   0  *
        6 *   18.0    4.5    11.3  *     .4              .4   * X     *   0  *
        7 *   22.0     .5    11.3  *                          *       *   0  *
        8 *   22.0    3.0    12.5  *    1.2             1.2   * X     *   0  *
        9 *   19.5    7.0    13.3  *     .4              .4   *       *   0  *
       10 *   16.5    3.5    10.0  *     .4              .4   *       *   0  *
       11 *   14.5    4.0     9.3  *    M                 M   *       *   0  *
       12 *   15.0    4.0     9.5  *    M                 M   * X     *   0  *
       13 *   17.5    5.0    11.3  *   12.2            12.2   * X     *   0  *
       14 *   21.0     .5    10.8  *    3.8             3.8   *       *   0  *
       15 *   18.0    4.0    11.0  *     .4              .4   * X     *   0  *
       16 *   14.5    2.0     8.3  *   16.0            16.0   *       *   0  *
       17 *    8.0    2.5     5.3  *    2.6             2.6   *       *   0  *
       18 *   18.0    4.0    11.0  *                          *       *   0  *
       19 *   22.0    1.0    11.5  *                          *       *   0  *
       20 *   24.0     .5    12.3  *                          *       *   0  *
       21 *   24.0    1.5    12.8  *                          *       *   0  *
       22 *   22.5    2.0    12.3  *    2.8             2.8   * X     *   0  *
       23 *   14.5    1.5     8.0  *    2.6             2.6   * X     *   0  *
       24 *   18.5    1.5    10.0  *    1.6             1.6   *       *   0  *
       25 *   14.5    2.5     8.5  *    M                 M   * X     *   0  *
       26 *    5.5    1.0     3.3  *    M                 M   *       *   0  *
       27 *   10.0    2.5     6.3  *   19.4            19.4   *       *   0  *
       28 *   13.0    1.0     7.0  *    3.2             3.2   *       *   0  *
       29 *   15.5    2.5     9.0  *    T                 T   *       *   0  *
       30 *   19.0    1.0    10.0  *                          *       *   0  *
       31 *   22.0    -.5    10.8  *                          *       *   0  *
          **********************************************************************

    TOTAL    523.0   83.5          *   90.0    0.0    90.0  *11 0 0 *
    MEAN      16.9    2.7     9.8

MONTHLY MAXIMUM TEMPERATURE WAS   24.0 ON DAY  20  21
MONTHLY MINIMUM TEMPERATURE WAS    -.5 ON DAY  31

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS 254.0

MONTHLY RAINFALL NOT VALID - MISSING DATA
LIST OF CODES USED IS AVAILABLE ON REQUEST
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FORDING RIVER COMINCO           CLIMATE SUMMARY FOR       AUGUST      1986
                         B.C. REGIONAL ID :    25000
                         AES HEADQUARTERS ID : 1152899

            ***************************************************************
        DAY *      TEMPERATURE      *           TOTAL           * T Z H * SNOW *
            *   MAX    MIN    MEAN  *   RAIN   SNOW      PCP    * H R A * GND  *
            ***************************************************************
          1 *   24.0    0.0   12.0  *    M                M     *       *   0  *
          2 *   25.5    2.0   13.8  *    M                M     *       *   0  *
          3 *   25.0    6.0   15.5  *    M                M     * X     *   0  *
          4 *   24.0    4.0   14.0  *    1.4              1.4   *       *   0  *
          5 *   17.0    6.0   11.5  *    4.8              4.8   * X   X *   0  *
          6 *   21.0    1.0   11.0  *                           *       *   0  *
          7 *   25.5    1.5   13.5  *                           *       *   0  *
          8 *   25.0    2.0   13.5  *                           *       *   0  *
          9 *   22.0    8.0   15.0  *    M                M     *       *   0  *
         10 *   25.5    1.5   13.5  *   10.4             10.4   * X     *   0  *
         11 *   25.0    5.5   15.3  *                           * X     *   0  *
         12 *   24.0    1.5   12.8  *    1.2              1.2   *       *   0  *
         13 *   21.5    5.0   13.3  *                           *       *   0  *
         14 *   22.5    0.0   11.3  *                           *       *   0  *
         15 *   21.0    8.0   14.5  *                           *       *   0  *
         16 *   20.0    1.5   10.8  *                           *       *   0  *
         17 *   25.0    0.0   12.5  *                           *       *   0  *
         18 *   26.0    0.0   13.0  *                           *       *   0  *
         19 *   18.0    1.0    9.5  *                           *       *   0  *
         20 *   22.0   -3.0    9.5  *                           *       *   0  *
         21 *   20.0   -2.0    9.0  *                           *       *   0  *
         22 *   22.0   -2.5    9.8  *                           *       *   0  *
         23 *   21.0    0.0   10.5  *    T                T     *       *   0  *
         24 *   14.0     .5    7.3  *    1.4              1.4   *       *   0  *
         25 *   20.5   -2.5    9.0  *                           *       *   0  *
         26 *   26.0     .5   13.3  *                           *       *   0  *
         27 *   27.0    1.0   14.0  *                           *       *   0  *
         28 *   28.0    3.5   15.8  *    T                T     *       *   0  *
         29 *   26.0    7.5   16.8  *    M                M     * X     *   0  *
         30 *   11.5    9.5   10.5  *    M                M     * X     *   0  *
         31 *   15.0    9.0   12.0  *   38.6             38.6   *       *   0  *
            ***************************************************************

        TOTAL  690.5   76.0         *   57.8    0.0     57.8  * 6 0 1 *
        MEAN    22.3    2.5   12.4

MONTHLY MAXIMUM TEMPERATURE WAS   28.0 ON DAY  28
MONTHLY MINIMUM TEMPERATURE WAS   -3.0 ON DAY  20

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS 174.2

MONTHLY RAINFALL NOT VALID - MISSING DATA
LIST OF CODES USED IS AVAILABLE ON REQUEST




MAIL 7,48
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WEATHER RECORD

EVENT: 75
STATION : FORDING RIVER
MONTH : FEB YEAR : 1983
YEAR: 1983

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5			0
6			0
7			0
8			0
9			0
10			0
11			0
12			0
13			0
14			0
15			0
16			0
17			0
18			0
19			0
20			0
21			0
22			0
23			0
24			0
25			0
26			0
27			0
28			0
29			0
30			0
31			0
TOTAL :	0	0	0

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH75A.wk2

WEATHER RECORD

EVENT: 75
STATION : FORDING RIVER
MONTH : MARCH
YEAR: 1983

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5			0
6			0
7			0
8			0
9			0
10			0
11			0
12			0
13			0
14			0
15			0
16			0
17			0
18			0
19			0
20			0
21			0
22			0
23			0
24			0
25			0
26			0
27			0
28			0
29			0
30			0
31			0
TOTAL :	0	0	0

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH75.wk2

(76,75)

FORDING RIVER AT THE MOUTH - STATION NO. 08NK018

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1983

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2.00B	1.97B	1.59E	2.08	7.13	30.4	10.6	6.31	3.32	2.70	2.26	1.93B
2	2.00B	1.97B	1.59E	2.03	7.01	25.2	9.99	6.10	3.31	2.63	2.31	1.73B
3	2.02B	1.99B	1.59E	2.06	7.24	27.0	10.8	5.87	3.33	2.43	2.50	1.76B
4	2.06B	1.89B	1.59E	2.09	7.33	29.6	11.5	5.65	3.30	2.58	3.53	1.79B
5	2.17B	1.85B	1.61E	2.10	7.44	27.4	12.7	5.46	3.36	2.58	3.22	1.89B
6	2.21B	1.80B	1.63E	2.11	7.90	25.9	12.9	5.29	3.26	2.58	3.03	1.85B
7	2.23E	1.76B	1.64E	2.11	9.01	25.7	13.2	5.15	3.19	2.52	2.90	1.86B
8	2.31B	1.75B	1.69E	2.12	9.59	25.0	13.4	5.04	3.18	2.47	2.77	1.83B
9	2.30E	1.71B	1.90E	2.18	9.50	23.6	13.0	4.98	3.18	2.41	2.69	1.83B
10	2.32B	1.70B	2.10E	2.15	9.04	21.4	11.6	4.90	3.14	2.37	2.68	1.90B
11	2.36B	1.68B	2.09E	2.14	8.76	19.0	10.7	4.94	3.10	2.35	2.64	1.90B
12	2.26B	1.63B	2.05E	2.15	9.01	17.4	10.3	4.81	3.02	2.33	2.61	1.90B
13	2.24B	1.63B	2.02E	2.16	9.73	15.6	10.3	4.59	2.95	2.32	2.55	1.90B
14	2.17B	1.63B	2.00E	2.17	10.8	14.8	11.3	4.44	2.90	2.32	2.54	1.90B
15	2.13B	1.60B	1.98E	2.24	11.4	14.6	10.9	4.38	2.84	2.30	2.52	1.83B
16	2.08B	1.60E	1.95A	2.41	11.6	14.0	11.0	4.26	2.78	2.28	2.49	1.87B
17	2.05B	1.61E	1.94	2.50	11.8	13.4	12.5	4.14	2.81	2.26	2.51	1.85B
18	2.07B	1.61E	1.93	2.61	12.5	13.3	12.2	4.18	2.86	2.33A	2.47	1.84B
19	2.09B	1.58E	1.96	2.74	12.4	12.3	11.7	4.23	2.92A	2.28A	2.45	1.81B
20	2.10B	1.59E	2.00	2.81	12.3	11.3	11.5	4.04	2.80A	2.17	2.40	1.80B
21	2.00B	1.59E	2.00	3.13	15.1	10.4	10.9	3.90	2.81	2.16	2.35	1.75B
22	1.96B	1.59A	2.00	3.62	18.7	9.79	10.1	3.89	2.75	2.34	2.26	1.74B
23	1.98B	1.59E	2.01	4.49	23.9	10.7	9.43	3.87	2.68	2.41	2.25	1.70B
24	2.03B	1.59E	2.02	7.85	27.0	12.6	8.86	3.86	2.59	2.27	2.36	1.68B
25	1.90B	1.60E	2.03	11.6	33.6	12.7	8.63	3.90	2.51	2.26	2.41	1.68B
26	1.90B	1.61E	2.03	10.1	39.0	11.3	8.59	3.83	2.49	2.19	2.53	1.70B
27	2.02B	1.60E	2.04	8.70	39.4	10.8	8.06	3.72	2.72	2.22	2.49	1.70B
28	2.04B	1.59E	2.06	7.89	37.5	10.4	7.55	3.72	2.83	2.16	2.34	1.73B
29	1.99B		2.07	7.42	39.4	10.2	7.17	3.59	2.64	2.17	2.18B	1.79B
30	1.97B		2.08	7.36	39.9	10.7	6.77	3.47	2.70	2.21	2.04B	1.82B
31	1.97B		2.08		34.3		6.49	3.36		2.23		1.88B
TOTAL	65.02	47.32	59.27	117.15	539.09	516.49	324.74	139.85	88.27	72.83	76.28	56.33
MEAN	2.10	1.69	1.91	3.91	17.4	17.2	10.5	4.51	2.94	2.35	2.54	1.82
MAX	2.36	1.99	2.10	11.6	39.9	30.4	13.4	6.31	3.36	2.70	3.53	1.93
MIN	1.90	1.58	1.59	2.08	7.01	9.79	6.49	3.36	2.49	2.16	2.04	1.68

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 5.76
MAXIMUM DAILY, 39.9 ON MAY 30
MINIMUM DAILY, 1.58E ON FEB 19
MAXIMUM INSTANTANEOUS,
42.2 AT 08:00 MST ON MAY 30

SUMMARY FOR THE YEAR 1983

TYPE OF GAUGE - RECORDING
LOCATION - LAT 49 53 38 N
LONG 114 52 08 W
DRAINAGE AREA, 619 km²
A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED
NATURAL FLOW

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	5 620	JUL	28 100
FEB	4 090	AUG	12 100
MAR	5 120	SEP	7 630
APR	10 100	OCT	6 290
MAY	45 600	NOV	6 590
JUN	44 600	DEC	4 870

TOTAL DISCHARGE, 182 000 dam³

FORDING RIVER BELOW CLODE CREEK - STATION NO. 08NK021

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1983

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	0.167B	0.160	0.154	0.228	1.47	7.15	2.25	1.16	0.621	0.393E	0.288A	0.146B	1
2	0.161B	0.155	0.153	0.230	1.41	5.80	2.12	1.11	0.627	0.390E	0.333E	0.143B	2
3	0.162B	0.152	0.151	0.236	1.41	6.79	2.38	1.03	0.611	0.390E	0.420E	0.140B	3
4	0.163B	0.150B	0.153	0.236	1.40	6.98	2.89	0.975	0.618	0.350E	0.578A	0.137B	4
5	0.164B	0.147B	0.157	0.238	1.43	6.67	3.42	0.934	0.618	0.385E	0.558E	0.134B	5
6	0.165B	0.144B	0.159	0.241	1.56	6.48	3.33	0.915	0.598	0.380A	0.540E	0.132B	6
7	0.167B	0.145B	0.160	0.249	1.85	6.60	4.13	0.894	0.644	0.370E	0.521A	0.130B	7
8	0.171B	0.146B	0.161	0.254	1.92	6.42	3.76	0.879	0.617	0.360E	0.510A	0.134B	8
9	0.176	0.149B	0.185	0.256	1.83	5.32	3.06	0.874	0.558	0.350E	[illegible]	0.140	
10	0.183	0.151B	0.225	0.256	1.70	5.18	2.56	0.905	0.554	0.344E	0.480E	0.141	10
11	0.179	0.156	0.216	0.247	1.71	4.55	2.31	0.873	0.503	0.336A	0.460E	0.147	11
12	0.172	0.148	0.197	0.245	1.87	4.03	2.31	0.828	0.487	0.412A	0.440E	0.149	12
13	0.169	0.149	0.202	0.241	2.15	3.38	2.34	0.787	0.460	0.324A	0.430E	0.148	13
14	0.165B	0.151	0.203	0.237	2.43	3.41	2.34	0.759	0.461	0.320A	0.420A	0.154	14
15	0.161B	0.149	0.205	0.241	2.61	3.55	2.08	0.747	0.467	0.320E	0.400A	0.153B	15
16	0.159B	0.154	0.208	0.258	2.61	3.17	2.08	0.781	0.464	0.316E	0.380A	0.151B	16
17	0.160B	0.147	0.198	0.297	2.87	3.09	2.15	0.768	0.477	0.312E	0.380A	0.148B	17
18	0.162B	0.144	0.192	0.393	3.15	3.12	2.10	0.811	0.481	0.308A	0.370E	0.145B	18
19	0.167	0.148	0.204	0.636	2.94	2.55	2.04	0.749	0.460	0.300A	0.350E	0.142B	19
20	0.168	0.143	0.197	1.12	3.09	2.26	1.98	0.730	0.433	0.300A	0.315E	0.139B	20
21	0.183	0.143	0.189	1.62	4.40	2.01	1.85	0.701	0.417	0.297A	0.273A	0.136B	21
22	0.169	0.146	0.182	2.06	5.19	2.01	1.74	0.706	0.398	0.303E	0.258A	0.133B	22
23	0.165	0.140	0.195	2.24	6.68	2.85	1.68	0.718	0.390	0.313E	0.198A	0.130B	23
24	0.170	0.153	0.209	3.54	7.02	4.05	1.65	0.743	0.375	0.300A	0.178	0.127B	24
25	0.164	0.171	0.210	3.48	9.01	3.14	1.66	0.733	0.363	0.291A	0.163	0.128B	25
26	0.157	0.165	0.228	2.50	10.4	2.59	1.59	0.718	0.357	0.285A	0.157B	0.130B	26
27	0.159	0.159	0.230	2.04	10.6	2.48	1.45	0.680	0.429	0.279	0.155B	0.131B	27
28	0.156	0.154	0.223	1.78	9.93	2.41	1.38	0.686	0.446A	0.282A	0.153B	0.130B	28
29	0.174		0.225	1.64	10.7	2.44	1.32	0.670	0.423E	0.274E	0.151B	0.130B	29
30	0.171		0.230	1.60	10.4	2.38	1.27	0.648	0.406E	0.269E	0.149B	0.132B	30
31	0.166		0.230		8.45		1.23	0.625		0.264A		0.136B	31
TOTAL	5.195	4.219	6.030	28.639	133.79	123.42	68.41	25.135	14.793	10.162	10.508	4.299	TOTA
MEAN	0.168	0.151	0.195	0.961	4.32	4.11	2.21	0.811	0.493	0.328	0.350	0.139	MEAN
MAX	0.188	0.171	0.230	3.54	10.7	7.15	4.13	1.16	0.644	0.412	0.578	0.154	MAX
MIN	0.156	0.140	0.151	0.228	1.40	2.01	1.23	0.625	0.357	0.264	0.149	0.127	MIN

DISCHARGES IN CUBIC METRES PER SECOND

MEAN, 1.19
MAXIMUM DAILY, 10.7 ON MAY 29
MINIMUM DAILY, 0.127B ON DEC 24
MAXIMUM INSTANTANEOUS,
12.5 AT 23:35 MST ON MAY 29

SUMMARY FOR THE YEAR 1983

TYPE OF GAUGE - RECORDING
LOCATION - LAT 50 12 05 N
LONG 114 52 57 W
DRAINAGE AREA, 104 km²
A - MANUAL GAUGE
B - ICE CONDITIONS
E - ESTIMATED
NATURAL FLOW

MONTHLY TOTAL DISCHARGE
IN CUBIC DECAMETRES

JAN	449	JUL	5 910
FEB	355	AUG	2 170
MAR	521	SEP	1 280
APR	2 490	OCT	878
MAY	11 600	NOV	908
JUN	10 700	DEC	371

TOTAL DISCHARGE, 37 600 dam³

WEATHER RECORD

EVENT: 79
STATION : FORDING RIVER
MONTH : JUNE
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1	2.8		2.8
2			0
3			0
4	4.4		4.4
5	1		1
6	3		3
7	1.2		1.2
8	5		5
9			0
10			0
11			0
12			0
13			0
14	11.6		11.6
15			0
16	0.6		0.6
17	0.8		0.8
18	3.4		3.4
19			0
20	0.6		0.6
21			0
22			0
23			0
24			0
25			0
26			0
27	3		3
28	1.6		1.6
29	3.8		3.8
30	1.2		1.2
31	0.2		0.2
TOTAL :	44.2	0	44.2

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH79A.wk2

WEATHER RECORD

EVENT: 79
STATION : FORDING RIVER
MONTH : JULY
YEAR: 1986

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2	8		8
3	5.4		5.4
4	5.8		5.8
5	3.8		3.8
6	0.4		0.4
7			0
8	1.2		1.2
9	0.4		0.4
10	0.4		0.4
11			0
12			0
13	12.2		12.2
14	3.8		3.8
15	0.4		0.4
16	16		16
17	2.6		2.6
18			0
19			0
20			0
21	2.8		2.8
22	2.8		2.8
23	2.6		2.6
24	1.6		1.6
25			0
26			0
27	19.4		19.4
28	3.2		3.2
29			0
30			0
31			0
TOTAL :	92.8	0	92.8

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH79.wk2

WEATHER RECORD

EVENT: 80
STATION : FORDING RIVER
MONTH : JAN
YEAR: 1987

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5			0
6		4.2	4.2
7			0
8			0
9			0
10			0
11		5	5
12		7.4	7.4
13		2.2	2.2
14			0
15			0
16			0
17			0
18		8	8
19			0
20		1.2	1.2
21			0
22			0
23			0
24			0
25			0
26		5.4	5.4
27		3.2	3.2
28		4.4	4.4
29			0
30			0
31		11.2	11.2
TOTAL :	0	52.2	52.2

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH80.wk2

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SPARWOOD                           CLIMATE SUMMARY FOR       JUNE        1985
                             B.C. REGIONAL ID :     69100
                             AES HEADQUARTERS ID : 1157630


          ***************************************************************
     DAY  *      TEMPERATURE      *           TOTAL         * T Z H * SNOW *
          *   MAX    MIN    MEAN  *    RAIN   SNOW     PCP  * H R A * GND  *
          ***************************************************************
       1  *   16.2    3.0    9.6  *    3.7             3.7  * X     *  0   *
       2  *   15.4    3.6    9.5  *    1.1             1.1  *       *  0   *
       3  *   17.8    5.6   11.7  *    T               T    *       *  0   *
       4  *   15.6    3.8    9.7  *    T               T    *       *  0   *
       5  *   13.6    8.5   11.1  *    1.9             1.9  *       *  0   *
       6  *   13.4    5.1    9.3  *    8.7             8.7  *       *  0   *
       7  *   13.0    7.8   10.4  *   21.8            21.8  * X     *  0   *
       8  *   12.6    6.7    9.6  *    T               T    *       *  0   *
       9  *   16.8     .5    8.7  *                         *       *  0   *
      10  *   18.1    1.8   10.0  *    T               T    *       *  0   *
      11  *   22.5    1.5   12.0  *                         *       *  0   *
      12  *   22.4    6.5   14.5  *     .3              .3  *       *  0   *
      13  *   17.5   10.2   13.9  *    T               T    *       *  0   *
      14  *   17.6    5.5   11.6  *    5.1             5.1  *       *  0   *
      15  *   20.2    8.6   14.4  *                         *       *  0   *
      16  *   20.3    3.2   11.8  *                         *       *  0   *
      17  *   22.5    1.8   12.2  *                         *       *  0   *
      18  *   26.5    3.2   14.9  *                         *       *  0   *
      19  *   28.4    5.3   16.9  *     .7              .7  *       *  0   *
      20  *   17.0    6.8   11.9  *   14.4            14.4  * X     *  0   *
      21  *   21.1    4.8   13.0  *    T               T    *       *  0   *
      22  *   21.2   10.3   15.8  *                         *       *  0   *
      23  *   19.0    2.5   10.8  *    T               T    *       *  0   *
      24  *   15.0    1.5    8.3  *                         *       *  0   *
      25  *   17.8    2.3   10.1  *    T               T    *       *  0   *
      26  *   22.4     .8   11.6  *                         *       *  0   *
      27  *   25.4    3.4   14.4  *    1.4             1.4  * X     *  0   *
      28  *   28.2    7.3   17.8  *                         *       *  0   *
      29  *   25.4    7.9   16.7  *     .3              .3  * X     *  0   *
      30  *   27.9    5.7   16.8  *                         *       *  0   *
          ***************************************************************

     TOTAL   591.0 145.5          *   59.4    0.0   59.4  * 5 0 0 *
     MEAN     19.7    4.9   12.3

MONTHLY MAXIMUM TEMPERATURE WAS   28.4 ON DAY  19
MONTHLY MINIMUM TEMPERATURE WAS     .5 ON DAY   9
HIGHEST RAINFALL WAS  21.8 ON DAY   7
NUMBER OF DAYS WITH MEASUREABLE PRECIPITATION IS 11

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS 170.8

LIST OF CODES USED IS AVAILABLE ON REQUEST
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SPARWOOD                        CLIMATE SUMMARY FOR      JULY        1985
                        B.C. REGIONAL ID :   69100
                        AES HEADQUARTERS ID : 1157630

               *************************************************************
           DAY *    TEMPERATURE      *         TOTAL          * T Z H * SNOW *
               *   MAX   MIN   MEAN  *  RAIN  SNOW     PCP    * H R A * GND  *
               *************************************************************
             1 *   27.7   4.8  16.3  *                        *       *  0   *
             2 *   30.8   4.5  17.7  *                        *       *  0   *
             3 *   30.4   7.2  18.8  *                        *       *  0   *
             4 *   31.6   7.5  19.6  *                        *       *  0   *
             5 *   27.9  12.0  20.0  *                        *       *  0   *
             6 *   27.9   6.5  17.2  *                        *       *  0   *
             7 *   29.9   7.1  18.5  *                        *       *  0   *
             8 *   32.7   8.4  20.6  *                        *       *  0   *
             9 *   32.8   7.2  20.0  *   T              T     *       *  0   *
            10 *   31.8  10.3  21.1  *                        *       *  0   *
            11 *   29.0   8.5  18.8  *                        *       *  0   *
            12 *   27.8  10.2  19.0  *                        *       *  0   *
            13 *   23.8   8.5  16.2  *   T              T     *       *  0   *
            14 *   26.5   4.0  15.3  *                        *       *  0   *
            15 *   28.1   6.6  17.4  *   T              T     *       *  0   *
            16 *   26.6  10.8  18.7  *    .9             .9   * X     *  0   *
            17 *   17.6   9.3  13.5  *   5.0            5.0   * X     *  0   *
            18 *   26.3   3.8  15.1  *                        *       *  0   *
            19 *   28.6   5.0  16.8  *                        *       *  0   *
            20 *   31.0   8.5  19.8  *                        *       *  0   *
            21 *   32.4   9.5  21.0  *                        *       *  0   *
            22 *   31.2   7.3  19.3  *                        *       *  0   *
            23 *   24.4  14.2  19.3  *   4.8            4.8   * X     *  0   *
            24 *   26.1   8.3  17.2  *                        *       *  0   *
            25 *   27.2   5.4  16.3  *                        *       *  0   *
            26 *   29.7  10.6  20.2  *                        *       *  0   *
            27 *   28.2   7.5  17.9  *                        *       *  0   *
            28 *   26.3   7.0  16.7  *                        *       *  0   *
            29 *   25.8   7.0  16.4  *                        *       *  0   *
            30 *   25.8   7.2  16.5  *                        *       *  0   *
            31 *   28.3   7.6  18.0  *                        *       *  0   *
               *************************************************************

           TOTAL  874.2 242.3        *  10.7   0.0    10.7    * 3 0 0 *
           MEAN    28.2   7.8  18.0

MONTHLY MAXIMUM TEMPERATURE WAS   32.8 ON DAY   9
MONTHLY MINIMUM TEMPERATURE WAS    3.8 ON DAY  18
HIGHEST RAINFALL WAS   5.0 ON DAY  17
NUMBER OF DAYS WITH MEASUREABLE PRECIPITATION IS  3

NUMBER OF HEATING DEGREE-DAYS FOR MONTH IS  23.5

LIST OF CODES USED IS AVAILABLE ON REQUEST
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7/

WATER SURVEY OF CANADA
FEB 19 1986 PAGE 10
VANCOUVER, B.C. 10:31

FORDING RIVER AT THE MOUTH

STATION NO. 08NK018

DAILY DISCHARGE IN CUBIC METRES PER SECOND FOR 1985 1985

Dec31'84 1.35 B

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DAY
1	1.25 B	1.19 B	1.35 B	1.70 B	6.19 E	22.0	8.54	3.77	3.83	4.82 A	3.65 E	2.28 B	1
2	1.30 B	1.16 B	1.34 B	2.05 B	7.26 E	20.8	8.17	3.61	3.81	4.75 E	3.74 E	2.31 B	2
3	1.35 B	1.17 B	1.24 B	M2.36 B	9.60 E	19.2	7.99	3.82	3.72	4.70 E	3.69 E	2.27 B	3
4	1.34 B	1.15 B	1.21 B	2.36 B	12.9 E	18.1	7.79	3.70	3.82	4.65 E	3.69 E	2.44 B	4
5	1.40 B	1.21 B	1.27 B	2.36 B	12.9 E	17.9	7.53	3.64	3.75	4.60 E	3.71 E	2.49 B	5
6	1.37 B	M1.25 B	M1.25 B	2.46 E	12.0 E	17.0	7.16	3.66	4.15	4.63 A	3.53 E	2.50 B	6
7	M1.37 B	1.25 B	1.25 B	2.50 E	12.0 E	15.5	7.02	3.55	4.33	4.52	3.45 B	2.46 B	7
8	1.37 B	1.24 B	1.30 B	2.53 E	12.6 E	27.5	5.79	3.54	4.15	4.52	3.33 B	2.41 B	8
9	1.36 B	1.22 B	1.27 B	2.64 E	13.4 E	22.4	5.55	3.73	4.05	4.42	3.15 E	2.30 B	9
10	1.36 B	1.24 B	1.27 B	2.92 E	12.6 E	19.2	5.34	3.65	4.04	4.22	2.95 B	2.20 B	10
11	1.35 B	1.34 B	1.25 B	3.16 E	13.4 E	17.4	5.19	3.61	4.06	4.09	2.80 B	2.21 B	11
12	1.39 B	1.35 B	1.30 B	3.59 E	12.7 E	17.1	6.02	3.81	6.92	3.89	2.61 B	2.23 B	12
13	1.40 B	1.36 B	1.33 B	4.07 E	12.1 E	16.9	5.57	3.74	12.5	3.81	2.66 B	2.24 B	13
14	1.44 B	1.40 B	1.35 B	5.36 E	12.1 E	16.3	5.65	3.72	11.2	3.78	2.66 B	2.24 B	14
15	1.45 B	1.39 B	1.43 B	5.35 E	12.6 A	15.8	5.40	4.24	9.72	3.72	2.50 B	2.26 B	15
16	1.46 B	1.36 B	1.52 B	6.90 E	15.4 A	15.6	5.33	4.52	6.74	3.72 A	3.05 B	2.30 B	16
17	1.53 B	1.37 B	1.65 B	7.19 A	20.1 A	14.2	5.67	4.59	8.06	3.71 E	2.85 B	2.40 B	17
18	1.50 B	1.38 B	1.89 B	7.04	24.5	13.5	5.74	4.53	7.54	3.70 A	2.80 B	2.30 B	18
19	1.45 B	1.38 B	2.03 B	6.94	30.1	13.8	5.26	4.94	7.16	3.67	2.70 B	2.20 B	19
20	1.44 B	1.39 B	2.33 B	6.58	31.2	14.7	5.09	4.94	6.67	3.69	2.55 B	2.10 B	20
21	1.47 B	1.38 B	2.10 B	6.03	31.9	13.5	4.90	4.99	6.32	3.67	2.40 B	2.00 B	21
22	1.48 B	1.41 B	1.90 B	5.58 A	32.3	12.1	4.77	5.15	6.21	3.65	2.25 B	1.90 B	22
23	1.50 B	1.45 B	1.60 B	5.45 E	33.3	11.5	4.69	5.08	6.04	3.65	2.21 B	1.80 B	23
24	1.47 B	1.44 B	1.53 B	5.21 E	33.4	10.7	4.67	4.99	5.82	3.55 E	2.25 B	1.70 B	24
25	1.46 B	1.39 B	1.45 B	5.08 E	34.0	9.55	4.51	4.97	5.54	3.90 E	2.27 B	1.60 B	25
26	1.45 B	1.36 B	1.43 B	4.94 E	31.6	9.01	4.34	4.70	5.40	3.24 E	2.24 B	1.52 B	26
27	1.44 B	1.39 B	1.45 B	4.72 E	25.3	8.79	4.20	4.48	5.37	3.68 E	2.20 B	1.42 B	27
28	1.43 B	1.42 B	1.44 B	4.96 E	22.5	8.90	4.14	4.30	5.25	4.54 E	M2.24 B	1.44 B	28
29	1.21 B		1.45 B	5.25 E	21.7	8.82	4.00	4.15	5.02	3.50 E	2.26 B	1.45 B	29
30	1.20 B		1.50 B	5.70 E	22.1	8.77	3.94	3.97	4.59	3.41 E	2.25 E	1.50 B	30
31	1.17 B		1.53 B		22.3		3.89	3.90		3.43 E		1.50 B	31
TOTAL	43.26	27.06	46.09	133.97	507.35	460.54	178.53	130.41	176.05	124.07	86.02	64.10	TOTAL
MEAN	1.40	1.32	1.49	4.47	19.6	15.4	5.76	4.21	5.94	4.00	2.87	2.07	MEAN
DAM3	3740	3200	3960	11600	52500	39800	15400	11300	15400	10700	7430	5540	DAM3
MAX	1.53	1.45	2.33	7.15	34.0	27.5	8.54	5.15	12.5	4.82	3.85	2.50	MAX
MIN	1.17	1.15	1.21	1.70	6.19	8.77	3.89	3.54	3.72	3.24	2.20	1.42	MIN

SUMMARY FOR THE YEAR 1985
MEAN DISCHARGE, 5.72 M3/S
TOTAL DISCHARGE, 181000 DAM3
MAXIMUM DAILY DISCHARGE, 34.0 M3/S ON MAY 25
MINIMUM DAILY DISCHARGE, 1.16 M3/S ON FEB 4

MAXIMUM INSTANTANEOUS DISCHARGE, 34.6 / M3/S AT 10:00 MST ON May 25 (g.h. 1.185)

A-MANUAL GAUGE
B-ICE CONDITIONS
E-ESTIMATED

Curve No. 15 all year.

PREPARED BY/DATE: W. J. Hurst. Feb. 26, 1986.
CHECKED BY/DATE: W. J. Hurst. Feb. 26, 1986.

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Environment Atmospheric

CLIMATOLOGICAL STATION REPORT

STATION DENISON PLANTSITE

PROVINCE B.C.

MONTH JULY 1984

ne of observation 8.00 a.m. 4.00 p.m.

server KIM BITTMAN

T ☐
P ☐

(112)

TIME OF OBSERVATION 2	TEMPERATURE (°C) Maximum		Minimum			PRECIPITATION Rain		Snow			TIMES OF PRECIPITATION (Calendar Day)		Depth of Snow on Ground	Weather (Calendar Day)			REMARKS
	Observed 3	For Day 4	Observed 5	For Day 6	AFTER RESET 7	Measured 8 mm	For Day 9 mm	Measured 10 cm	For Day 11 cm	Total For Day 12 mm	Began 13	Ended 14	whole cm 15	Thunderstorm 16	Freezing Rain 17	Hail 18	19
a.m.																	
p.m.		15.0		10.0			0.2			0.2							SUNNY/CLOUD
a.m.																	
p.m.		16.0		17.0			0.4			0.4							SUNNY
a.m.	16.0		7.0		14.0												
p.m.	19.0	19.0	13.0	7.0	19.0												SUNNY
a.m.	19.0		10.0		18.0												
p.m.	19.0	19.0	13.0	10.0	16.0	0.4	0.6			0.6							CLOUD/SUN
a.m.	17.0		9.0		17.0	0.2											
p.m.	16.0	16.0	12.0	9.0	14.0		0.4			0.4							CLOUDY
a.m.	14.0		5.0		10.0	0.4											
p.m.		16.0		9.0													CLOUD/SUN
a.m.																	
p.m.		16.0		9.0													SUNNY/CLOUD
a.m.																	
p.m.		18.0		13.0													SUNNY/CLOUD
a.m.	16.0		5.0		16.0												
p.m.	19.0	19.0	13.5	5.0	19.0												SUNNY
a.m.	19.0		10.0		16.0												
p.m.	17.0	19.0	13.0	10.0	17.0												CLOUD/SUN
a.m.	19.0		9.0		16.0												
p.m.	24.0	24.0	13.0	9.0	14.0												CLEAR
a.m.	16.0		14.0		16.0												
p.m.	22.0	22.0	9.0	9.0	15.0												CLOUDY
a.m.	18.0		10.0		13.0												
p.m.	17.0	17.0	13.0	10.0	17.0												CLEAR
a.m.																	
p.m.		22.0		12.0													SUNNY
a.m.																	
p.m.		24.0		14.0													VERY SUNNY
a.m.	22.0		9.0		19.0												
p.m.	24.0	24.5	19.0	9.0	24.0												CLOUD/SUN
a.m.	24.5		10.0		15.0												
p.m.	20.0	20.0	14.0	5.0	20.0												SUNNY
a.m.	20.0		5.0		7.0												
p.m.	16.5	17.0	7.0	5.0	16.0												CLOUD/SUN
a.m.	17.0		6.0		12.0												
p.m.	18.0	18.0	6.0	6.0	17.0												CLOUD/SUN
a.m.																	
p.m.		17.0		10.0		4.6	4.6			4.6							CLOUD/RAIN
a.m.																	
p.m.		18.0		9.0		2.2	2.2			2.2							CLOUD/RAIN
a.m.																	
p.m.		25.0		9.0													SUNNY
a.m.	24.0		7.0		15.0												
p.m.	29.0	29.0	13.0	7.0	25.0												SUNNY
a.m.	27.0		9.0		15.0												
p.m.	30.5	31.0	14.0	9.0	30.0												SUNNY/HOT
a.m.	31.0		9.5		19.0												
p.m.	32.5	33.0	18.0	9.5	32.0												SUNNY/HOT
a.m.	33.0		12.0		17.0												
p.m.	32.0	32.0	17.0	12.0	32.0												CLOUD/SUN
a.m.	31.0		13.0		17.0												
p.m.	31.0	31.0	13.0	13.0	22.5	0.4	0.4			0.4							SUN/CLOUD
a.m.																	
p.m.		29.0		13.0													SUNNY
a.m.																	
p.m.		32.0		15.5													SUNNY
a.m.	27.0		10.0		19.0												
p.m.	32.5	32.5	17.0	10.0	29.0												SUNNY
a.m.	32.0		14.0		20.0												
p.m.	32.0	32.0	19.0	14.0	31.0												SUNNY
a.m.	30.0										Total no. of days with						
ANS		703		309			8.8			8.8							
ANS		22.67		10.0													

TEMPERATURE EXTREMES

Maximum 33.0 Date 27

Minimum 5.0 Date 18

TEMPERATURE

Mean Max. 22.67

Mean Min 10.0

Mean 16.8

of observation 8-00 a.m. 4:00 p.m. 11AW T ☐ P ☐ PROVINCE B.C. 11

rver KIM BITTMAN MONTH AUGUST 1984

(112)

OBSERVATION	TEMPERATURE (°C) Maximum Observed 3 H	Maximum For Day 4	Minimum Observed 5 L	Minimum For Day 6	AFTER RESET 7 P	PRECIPITATION Rain Measured 8 mm	Rain For Day 9 mm	Snow Measured 10 cm	Snow For Day 11 cm	Total For Day 12 mm	TIMES OF PRECIPITATION (Calendar Day) Began 13	Ended 14	Depth of Snow on Ground whole cm 15	Weather (Calendar Day) Thunderstorm 16	Freezing Rain 17	Hail 18	REMARKS 19
a.m.			13.5		17.5												
p.m.	26.0	27.0	17.5	13.5	26.0												SUNNY/HOT
a.m.	27.0		12.0		19.0												
p.m.	28.5	28.5	12.0	12.0	26.0												SUNNY
a.m.	25.5		10.0		15.0												
p.m.	28.0	28.0	15.0	10.0	26.0												SUNNY
a.m.																	
p.m.		30.0		15.0			0.6			0.6							SUNNY
a.m.						0.6											
p.m.		30.0		15.0		8.8	8.8			8.8							CLOUD/RAIN
a.m.																	
p.m.		21.0		14.0													CLOUD/SUN
a.m.	28.0		10.5		15.5												
p.m.	19.0	19.0	13.5	10.5	19.0												SUN/CLOUD
a.m.	19.0		11.0		17.0												
p.m.	29.0	29.0	14.0	11.0	30.0												SUNNY
a.m.	29.0		16.0		17.0												
p.m.	22.0	22.0	16.5	16.0	21.0												SUNNY/CLOUD
a.m.	22.0		10.5		19.5												
p.m.	19.5	19.5	13.0	10.5													SUNNY/CLOUD
a.m.																	
p.m.		27.0		+8.0													SUNNY
a.m.																	
p.m.		28.0		11.0		5.6	7.8			7.8							CLOUD/RAIN
a.m.	27.0		5.0		14.0	2.2											
p.m.	14.0	14.0	11.0	5.0	14.0	10.8	11.2			11.2							OVERCAST/RAIN
a.m.	14.0		6.0		6.5	0.4											OVERCAST
p.m.	8.0	9.5	6.0	6.0	8.0	6.0	6.0			6.0							~~SUNNY~~ / CLOUD
a.m.	9.5		7.5		9.5												
p.m.	20.0	20.0	9.5	7.5	19.0												SUNNY/CLOUD
a.m.	19.0		4.5		11.0												
p.m.	27.0	27.0	11.0	4.5	26.0												CLOUD/SUN
a.m.	26.0		9.0		15.5												
p.m.	25.0	26.0	15.5	9.0	13.0												CLOUD/SUN
a.m.																	
p.m.		19.0	1	10.0													SUN/CLOUD
a.m.																	
p.m.		19.0		11.0													SUN/CLOUD
a.m.	19.0		8.0		11.0												
p.m.	18.5	18.5	11.0	8.0	17.5												SUNNY
a.m.	17.0		7.5		11.5												
p.m.	26.0	26.0	11.5	7.5	26.0		0.2			0.2							SUNNY
a.m.	25.0		9.0		11.0	0.2											
p.m.	22.0	22.0	11.0	9.0	17.0												CLOUD/SUN
a.m.	19.5		11.5		14.0												
p.m.	17.5	17.5	14.0	11.5	15.0												CLOUD/SUN
a.m.	17.0		7.0		13.0												
p.m.	17.0	17.0	13.0	7.0	16.5												SUNNY/CLOUD
a.m.																	
p.m.		17.0		14.0													CLOUDY
a.m.																	
p.m.		19.0		16.0		0.4	0.4			0.4							CLOUD/SUN
a.m.	17.0		6.0		10.0												
p.m.	16.0	16.0	10.0	6.0	14.0												CLOUD/SUN
a.m.	13.5		6.0		9.0												
p.m.	13.0	13.0	8.0	6.0	12.0												CLOUD/SUN
a.m.	11.0		4.0		6.5												
p.m.	13.0	13.0	6.5	4.0	12.0												CLOUD/SUN
a.m.	13.0		4.5		6.0												
p.m.	13.0	16.5	6.0	4.5	15.0												CLOUD/SUN
a.m.	16.5		5.0		8.5												
p.m.	15.0	16.0	9.0	5.0	14.0	2.6	2.6			2.6							OVERCAST
a.m.	16.0										Total no. of days with						
S		655		298			37.6		0	37.6							
NS		21.1		9.6													

TEMPERATURE EXTREMES

Maximum +30.0 Date A 8

Minimum +4.0 Date A29

TEMPERATURE

Mean Max. 21.1

Mean Min 9.6

Mean 15.4

PRECIPITATION ON FRAME / AUGUST 1 TO AUGUST 20, 1984

TIME/HO DAYS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	DAILY SUM	DAILY AVERAGE
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	3.75	0.25	0	1.5	0	0.25	6.25	0.2604
6	0	1	1	0.5	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.75	0.1145
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0.5	0.0208
9	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.0104
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0.0416
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0.0416
13	0	0	0	0	0	0	0	0	0	0	1.25	0	0.75	0.25	0	0	0.25	0	0	0	0	1	1.25	0.25	5	0.2083
14	0.25	0	0	0.25	0.5	0	0	0	0.25	0	0.25	0	1	0.5	0	0	0.25	0.25	0	0.25	0.25	0.5	3	1.75	9.25	0.3854
15	0	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.0104
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.25	0	0	0	0	0.25	0	0	0	1.5	0.0625
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	1.75	0	2.25	0.25	0.25	0	0.25	5	0.2083
19	0	0.25	0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0.0208
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0.5	0.0208
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0.5	0.0208
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0.25	1	0	0	0	0	0	0	0	0	0	0	0	0.25	0.25	0	0	0	0	0	0	0	0	0	1.75	0.0729
HOURLY SUMS	0.75	2.5	1.25	0.75	0.75	0	0	0	0.25	0	1.5	0	1.75	1	2.25	0.25	0.75	2.5	3.75	2.75	0.75	5.25	4.75	2.5	36	0.05
HOURLY AVERA	0.025	0.0833	0.0416	0.025	0.025	0	0	0	0.0083	0	0.05	0	0.0583	0.0333	0.075	0.0083	0.025	0.0833	0.125	0.0916	0.025	0.175	0.1583	0.0833	36	

112

e of observation 8 a.m. 4 p.m.

T ☐
P ☐

server

STATION [illegible]

PROVINCE B.C.

MONTH OCTOBER 1985

113

TIME OF OBSERVATION 2	TEMPERATURE (°C) Maximum Observed 3	Maximum For Day 4	Minimum Observed 5	Minimum For Day 6	AFTER RESET 7	PRECIPITATION Rain Measured 8 mm	Rain For Day 9 mm	Snow Measured 10 cm	Snow For Day 11 cm	Total For Day 12 mm	TIMES OF PRECIPITATION (Calendar Day) Began 13	Ended 14	Depth of Snow on Ground whole cm 15	Weather (Calendar Day) Thunderstorm 16	Freezing Rain 17	Hail 18	REMARKS 19
a.m.			7		7												
p.m.	11	11	7	7	10												CLE-R.
a.m.	11		5		6												
p.m.	11	11	6	5	10												INTER CLOUD
a.m.	10		1		1												
p.m.	9	9	1	1	8												CLEAR
a.m.	8		0		3												
p.m.																	OVERCAST.
a.m.																	
p.m.																	OVERCAST
a.m.																	
p.m.								1.5	1.5	2.0			1.5				SNOW/OVC
a.m.																	
p.m.																	CLEAR
a.m.	+4.0		-12		-10												
p.m.		+4		-12									0				CLEAR
a.m.	+2.0		-9		+1												
p.m.		+2		-9									0				HIGH CLOUDS
a.m.	+7		+2		+6												
p.m.	+6	+7	+5	+2	+5								0				OVERCAST
a.m.	+5		0		0												
p.m.	+2	+5	0	0	+2								0				OVERCAST, SNOWING
a.m.																	
p.m.																	
a.m.																	
p.m.																	
a.m.																	
p.m.							7		3	10							10mm RAIN AND SNOW OVER LONG WEEKEND - PARTITIONING ESTIMATED
a.m.	+8		+8		0												
p.m.	+1	8	0	0	0			10	10	14	0800	1600	10				OVERCAST & SNOWING, CALM
a.m.	+3		-1		0												
p.m.	+3	3	0	-1	+2		3			3			5				MOSTLY CLOUDY, SW WIND
a.m.	2		0		+1												
p.m.	4	4	1	0	3					0			2				CLEARING
a.m.	3		-4		1												
p.m.	3	3	1	-4	3					0			0				CLOUDING OVER IN A.M.
a.m.																	
p.m.										0			0				
a.m.																	
p.m.							7.5		1	8.5			0				8.5 mm RAIN AND SNOW OVER WEEKEND - PARTITIONING ESTIMATED.
a.m.	3		-4		-3												
p.m.	3	3	-3	-4	3					0			0				CLOUDY, CALM
a.m.	3		-2		-2												
p.m.	4	4	-2	-2	3			T		T	2100	2200	0				MOSTLY CLOUDY, CALM
a.m.	3		-1		0												
p.m.	4	4	-1	-1	1								0				CLOUDING OVER IN A.M. SUNNY [illegible] DAY
a.m.	1		-4		-3												
p.m.	1	1	-3	-4	0			1		0.8	2300	2400	1				CLEAR IN A.M. CLOUDING IN P.M.
a.m.	0		-4		-2												
p.m.	0	0	-2	-4	0												CLEAR
a.m.																	
p.m.																	CLOUDY
a.m.																	
p.m.									5.5	4.8	0100	1400	6				CLOUDY WITH SNOW
a.m.	0		-9		-8												
p.m.	0	0	-8	-9	-1								6				PARTLY CLOUDY
a.m.	-1		-4		-3												
p.m.	1	1	-3	-4	1								2				CLOUDY
a.m.	1		-4		-2												
p.m.	0	1	-2	-4	-1								2				SUNNY
a.m.	-1		-4		-2												
p.m.	1	1	-2	-4	0			T		T			2				PARTLY CLOUDY
a.m.	0										Total no. of days with			0	0	0	
UMS		117.0		-47.0			17.5		18.5	43.1							
EANS		6.0		-2.4													

TEMPERATURE EXTREMES

Maximum. +11 Date. 1,2

Minimum. -12 Date. 8

TEMPERATURE

Mean Max. +6.0 °C.

Mean Min. -2.4 °C

Mean. 1.8 °C

WEATHER RECORD

EVENT: 153
STATION : FORDING RIVER
MONTH : APRIL
YEAR : 1990

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4	3		3
5			0
6			0
7			0
8			0
9		11	11
10		5	5
11			0
12			0
13			0
14			0
15	14		14
16			0
17			0
18			0
19			0
20			0
21			0
22	2		2
23			0
24			0
25		10.6	10.6
26			0
27			0
28			0
29			0
30			0
31			0
TOTAL :	19	26.6	45.6

Note : Above records transcribed from climatological records held on file.

AHK/ak/kc
Disk/WEAT153a.wk2

WEATHER RECORD

EVENT: 153
STATION : FORDING RIVER
MONTH : MAY
YEAR: 1990

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1	9.4		9.4
2			0
3			0
4			0
5			0
6		0.5	0.5
7		0.5	0.5
8			0
9			0
10			0
11			0
12			0
13			0
14	15.6		15.6
15			0
16			0
17			0
18	5.2		5.2
19			0
20			0
21			0
22	8.2		8.2
23	0.6		0.6
24			0
25		2.5	2.5
26			0
27			0
28	24		24
29	8		8
30	15.2		15.2
31	3.3	6	9.3
TOTAL :	89.5	9.5	99

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH153.wk2

WEATHER RECORD

EVENT: 154
STATION : FORDING RIVER
MONTH : JUNE
YEAR: 1990

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1	2.5	7.3	9.8
2	8.6		8.6
3	0.6		0.6
4			0
5			0
6			0
7	5.7		5.7
8			0
9	0.5		0.5
10	0.5		0.5
11		6.5	6.5
12			0
13	2.7		2.7
14			0
15			0
16			0
17			0
18	1.8		1.8
19	1.4		1.4
20	0.8		0.8
21			0
22			0
23	2		2
24	0.2		0.2
25			0
26			0
27			0
28	0.4		0.4
29			0
30	0.4		0.4
31			0
TOTAL :	28.1	13.8	41.9

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEAT154a.wk2

WEATHER RECORD

EVENT: 154
STATION : FORDING RIVER
MONTH : JULY
YEAR: 1990

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1	0.5		0.5
2	3.2		3.2
3			0
4	1		1
5	7.6		7.6
6	10.3		10.3
7			0
8			0
9			0
10			0
11			0
12			0
13			0
14			0
15			0
16			0
17	3.5		3.5
18	9.8		9.8
19	5		5
20			0
21			0
22			0
23	3.8		3.8
24	11		11
25	21.3		21.3
26	12		12
27			0
28	2.6		2.6
29			0
30	0.4		0.4
31	3.3		3.3
TOTAL :	95.3	0	95.3

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH154.wk2

WEATHER RECORD

EVENT: 155
STATION : FORDING RIVER
MONTH : SEPT
YEAR: 1989

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5	18.5		18.5
6	4		4
7	1		1
8	2		2
9			0
10	6.4		6.4
11			0
12			0
13			0
14			0
15			0
16			0
17	4		4
18			0
19			0
20			0
21			0
22			0
23			0
24			0
25			0
26			0
27			0
28			0
29	0.8		0.8
30			0
31	0.5	0.5	1
TOTAL :	37.2	0.5	37.7

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH155.wk2

WEATHER RECORD

EVENT: 155
STATION : FORDING RIVER
MONTH : OCT
YEAR: 1989

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5			0
6	1.6		1.6
7			0
8			0
9			0
10	0.4		0.4
11			0
12	7.8		7.8
13	11.4		11.4
14			0
15			0
16	7.6		7.6
17			0
18			0
19			0
20	0.6		0.6
21			0
22			0
23	5.6		5.6
24	1		1
25			0
26			0
27			0
28		6.5	6.5
29			0
30		1.5	1.5
31			0
TOTAL :	36	8	44

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEAT155B.wk2

WEATHER RECORD

EVENT: 156
STATION : FORDING RIVER
MONTH : NOV
YEAR: 1989

DAY NO	RAINFALL (mm)	SNOWFALL (mm)	TOTAL PRECIP.
1			0
2			0
3			0
4			0
5			0
6			0
7		5	5
8			0
9	5		5
10	17.3		17.3
11		3	3
12			0
13		0.5	0.5
14		2	2
15			0
16			0
17			0
18			0
19	2.6		2.6
20	6.3	2	8.3
21			0
22			0
23		0.5	0.5
24			0
25			0
26		2.5	2.5
27			0
28			0
29			0
30			0
31			0
TOTAL :	31.2	15.5	46.7

Note : Above records transcribed from climatological records held on file.

AHK/ak
Disk/WEATH156.wk2

e of observation 8 a.m. 4 p.m.

erver S Hilts

T ☐
P ☐

STATION — 2099R 1182427-267 BC

PROVINCE DENISON PLANT SITE

MONTH OCTOBER 1987

157

TIME OF OBSERVATION	TEMPERATURE (°C) Maximum Observed 3	Maximum For Day 4	Minimum Observed 5	Minimum For Day 6	AFTER RESET 7	PRECIPITATION Rain Measured 8 mm	Rain For Day 9 mm	Snow Measured 10 cm	Snow For Day 11 cm	Total For Day 12 mm	TIMES OF PRECIPITATION (Calendar Day) Began 13	Ended 14	Depth of Snow on Ground 15 whole cm	Weather (Calendar Day) Thunderstorm 16	Freezing Rain 17	Hail 18	REMARKS 19
m.			14.0		15.0												
m.	25.0	25.0	15.0	14.0	25.0												Sunny, Calm
m.	25.0		8.0		10.0												
m.	21.5	25.0	10.0	8.0	21.0												Sunny
m.	21.0		5.0		8.0												
m.	15.0	21.0	8.0	5.0	15.0	1.4	1.4			1.4	1800	1900		✓			Cloudy
m.	15.0		4.0		6.0												
m.	13.0	15.0	6.0	4.0	12.0												Mostly Sunny
m.	12.0		3.0		9.0												
m.	11.0	12.0	9.0	3.0	10.0												
m.	10.0		-1.5		0.0												
m.	14.0	14.0	0.0	-1.5	13.0												
m.	13.0		5.0		5.0	0.2					0500	0515					
m.	9.0	13.0	5.0	5.0	8.5		0.2	0.8	0.8	1.0	0800	0930				✓	Snow/Rain
m.	8.5		-2.5		-1.5												
m.	6.0	8.5	-1.5	-2.5	6.0		T			T							Snow/Rain
m.	6.0		-6.5		-5.0												
m.	12.5	12.5	-5.0	-6.5	11.5												
m.	11.5		6.0		8.0												
m.	16.5	16.5	8.0	6.0	16.0												
m.	16.0		11.0		16.0												
m.	20.0	20.0	16.0	11.0	20.0												
m.	20.0		6.0		10.0												
m.	10.5	20.0	8.5	6.0	10.0												
m.	10.0		4.0		5.0												
m.	11.5	11.5	5.0	4.0	11.5												Sunny
m.	11.5		-5.0		-4.0												
m.	10.0	11.5	-4.0	-5.0	10.0												Mixed Cloud & Sun
m.	10.0		2.0		5.0												
m.	9.0	10.0	5.0	2.0	8.5												
m.	8.5		2.0		2.0	2.5					0300	0600					
m.	5.5	8.5	2.0	2.0	5.0		2.5			2.5							Mainly Sunny
m.	5.0		-3.0		-1.5												
m.	4.5	5.0	-1.5	-3.0	3.0												Sun, High Cloud
m.	3.0		2.0		2.0												
m.	8.5	8.5	2.0	2.0	7.0												Sunny
m.	7.0		-0.5		1.0												
m.	11.5	11.5	1.0	-0.5	10.0												Cirrus
m.	10.0		2.0		9.0												
m.	11.5	11.5	7.0	2.0	7.0												OVC
m.	7.0		-3.0		-1.0												
m.	10.0	10.0	-1.0	-3.0	9.0												Sunny
m.	9.0		-7.0		-6.0												
m.	12.0	12.0	-6.0	-7.0	12.0												
m.	12.0		-3.0		-3.0												
m.	12.0	12.0	-3.0	-3.0	9.0												
m.	8.5		6.0		7.5												
m.	10.5	10.5	7.5	7.5	8.0	T	T			T							
n.	8.0		3.5		3.5												
n.	8.0	8.0	3.5	3.5	6.0												
n.	6.0		1.5		2.0												
	6.5	6.5	2.0	1.5	5.0												Mainly Sunny
	5.0		2.0		5.5												
	10.0	10.0	5.5	2.0	8.0												Cloud/Sun
	9.0		4.5		9.0	1.2					0400	0800					
	9.5	9.5	8.0	4.5	8.0	1.6	2.8			2.8	0800	1200					Rain
	8.0		3.5		5.0	3.6					0800	0800					
	10.0	10.0	5.0	3.5	9.0	1.6	5.2			5.2	0800	1400					Rain
	9.0		5.0		8.0	2.1					0800	1600					
	8.0	9.0	6.5	6.5	6.5	0.7	2.8			2.8	1600	2100					Rain
	6.5		2.0		2.0												
	4.5	6.5	2.0	2.0	4.0	3.0	3.0			3.0	1330	2100					Rain
	4.0																
	381.5		73.0			12.9				12.7	Total no. of days with						
	12.4		2.1														

TEMPERATURE EXTREMES

Maximum 20.0 Date 11,12

Minimum -7.0 Date 22

TEMPERATURE

Mean Max. 12.4

Mean Min. 2.1

Mean 7.4

RAPPORT DE STATION CLIMATOLOGIQUE

STATION . 20896 1182427-267 EC —

PROVINCE DENISON PLANT SITE

·de l'observation 8 a.m. 4 p.m.

T☐
P☐

vateur S. Hilts

MOIS November 19 87

(157)

	TEMPÉRATURE (°C)					PRÉCIPITATIONS					DURÉE DE LA PRÉCIPITATION (Jour civil)		ÉPAISSEUR DE NEIGE AU SOL	TEMPS (Jour civil)			REMARQUES
L'OBSERVATION	Maximum		Minimum			Pluie		Neige		Total du jour W.E. mm 12	Début 13	Fin 14	cm entiers 15	Orage 16	Pluie se cong. 17	Grêle 18	19
	Observée 3	Du jour 4	Observée 5	Du jour 6	APRÈS REMISE EN ÉTAT 7	Mesurée mm 8	Du jour mm 9	Mesurée cm 10	Du jour cm 11								
m.			-1.0		0.0												
m.	5.0	5.0	0.0	-1.0	3.5												
m.	3.5		-1.5		2.5						1100						
m.	6.0	6.0	2.5	-1.5	5.0	1.5				1.5							
m.	5.0		0.0		1.0						0800	0800 1100			✓		Cloudy, Windy
m.	5.0	5.0	1.0	0.0	4.5	T	T	T		T							
m.	4.5		0.0		1.5												Cloudy
m.	5.0	5.0	1.5	0.0	4.5												
m.	4.5		-0.5		4.5												
m.	10.0	10.0	4.5	-0.5	9.0												
m.	9.0		-1.5		2.5												
m.	8.0	8.0	2.5	-1.5	8.0												
m.	8.0		1.0		3.0												Cloudy
m.	6.5	6.5	3.0	1.0	6.0	T				T							
m.	6.0		1.0		4.0												Sunny
m.	9.5	9.5	4.0	1.0	9.0												
m.	9.0		-0.5		5.0												
m.	11.0	11.0	5.0	-0.5	9.5												
m.	9.5		3.0		8.5						2300						Cloudy
m.	12.0	12.0	8.5	3.0	10.0	1.0	1.0			1.0							
m.	10.0		4.0		6.0							0100					Sunny/P.M. Cloud
m.	8.5	8.5	5.0	4.0	5.0	T	T			T							
m.	5.0		1.0		2.5												Sun/Cloud
m.	6.5	6.5	2.5	1.0	5.5												
m.	5.5		-2.5		-1.0			0.2					0.2				Snow
m.	2.0	2.0	-1.0	-2.5	1.0				0.2	0.2							
a.m.	1.0		-8.0		-8.0								0				Mostly Sunny
p.m.	1.0	1.0	-8.0	-8.0	1.0												
a.m.	-2.0		-9.0		-8.0								0				Sunny
p.m.	-2.0	-2.0	-8.0	-9.0	-2.0												
a.m.	-2.0		-13.0		-13.0								0				Sunny, Calm
p.m.	-2.0	-2.0	-13.0	-13.0	-2.0												
a.m.	-2.0		-6.0		-6.0								0				Sunny A.M., Cloudy P.M.
p.m.	0.5	0.5	-6.0	-6.0	0.5												
a.m.	0.5		-0.5		-0.5								0				Cloudy
p.m.	0.0	0.0	-0.5	-0.5	0.0												
a.m.	0.0		-2.5		-1.0								0				Cloudy, Rain/Snow
p.m.	-1.0	8.5	-2.5	-2.5	-1.0	1.8	1.8			1.8	0800	1300					
a.m.	8.5		-2.0		8.5								0				Cloudy
p.m.	12.5	12.5	8.5	-2.0	8.5												
a.m.	8.5		-0.5		0.0								0				Cloudy
p.m.	0.0	2.5	0.0	-0.5	2.5												
a.m.	2.5		-2.0		-2.0								0				Cloudy, Snow
p.m.	-1.0	2.5	-2.0	-2.0	-1.0			3	3	3.4	1600	1830					
a.m.	-1.0		-6.0		-3.0								3				Cloudy Sun
p.m.	2.5	2.5	-3.0	-6.0	2.0												
a.m.	2.0		1.0		1.0								2				Cloud, Flurries → Clear
p.m.	3.0	3.0	1.0	1.0	2.0												
a.m.	2.0		0.0		0.0								2				Cloud & Sun
p.m.	1.0	4.0	0.0	0.0	1.0												
a.m.	4.0		1.0		4.0								1				Mostly Cloudy
p.m.	7.0	7.0	4.0	1.0	6.0												
a.m.	6.0		3.0		4.0								0				
p.m.	5.0	5.0	4.0	3.0	5.0												
a.m.	5.0		4.0		5.0								0				
p.m.	8.0	8.0	5.0	4.0	8.0												
a.m.	8.0		-1.0		-1.0								0				
p.m.	4.0	4.0	-2.5	-2.5	2.0												
a.m.	2.0		-5.5		-0.5								0				Sunny
p.m.	5.5	5.5	-0.5	-5.5	2.0												
a.m.																	
p.m.																	
a.m.	2.0										Nbre total de jour avec						
MES		157.5		-43.0			4.3		3.2	7.9							
ENNE		5.3		-1.4													

TEMPÉRATURES EXTRÊMES

Maximum 12.5 Date 20

Minimum -13.0 Date 16

TEMPÉRATURE

Maximum moyenne 5.3

Minimum moyenne -1.4

Moyenne du mois 2.0

Environment Service · de l'environnement atmosphérique

CLIMATOLOGICAL STATION REPORT

1182421-267 BC

STATION DENISON PLANT SITE

PROVINCE B.C.

MONTH APRIL 1988

e of observation 8 a.m. 4 p.m.

T ☐
P ☐

erver S. Hilts

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TIME OF OBSERVATION 2	TEMPERATURE (°C) Maximum Observed 3	Maximum For Day 4	Minimum Observed 5	Minimum For Day 6	AFTER RESET 7	PRECIPITATION Rain Measured mm 8	Rain For Day mm 9	Snow Measured cm 10	Snow For Day cm 11	Total For Day w.e. mm 12	TIMES OF PRECIPITATION (Calendar Day) Began 13	Ended 14	Depth of Snow on Ground whole cm 15	Weather (Calendar Day) Thunderstorm 16	Freezing Rain 17	Hail 18	REMARKS 19
a.m.			3.0		5.5												
p.m.	6.5	6.5	2.0	-2.0	6.5												
a.m.	6.5		-4.0		-3.0												
p.m.	6.5	7.0	-3.0	-4.0	6.0												
a.m.	7.0		0.0		0.0												
p.m.	6.0	6.0	0.0	0.0	6.0												
a.m.	6.0		0.0		0.5												
p.m.	6.5	6.5	0.5	0.0	6.5												Sunny
a.m.	6.5		-3.5		-3.0												
p.m.	6.0	6.5	-3.0	-3.5	6.0			2.0	2.0	1.4	2000	2100					Overcast
a.m.	+6.5		-6.5		-3.5												
p.m.	5.0	6.0	-3.5	-6.5	5.0								2				Sunny
a.m.	6.0		-3.5		-2.0												
p.m.	4.0	4.5	-2.0	-3.5	4.0												
a.m.	4.5		-1.5		2.0												
p.m.	6.0	6.0	2.0	-1.5	6.0												
a.m.	6.0		-3.0		0.0												
p.m.	10.0	10.5	0.0	-3.0	9.0												
a.m.	10.5		2.5		5.5												
p.m.	14.5	14.5	5.5	2.5	14.5												Sunny
a.m.	14.5		-1.0		0.0												
p.m.	8.0	8.0	0.0	-1.0	+8.0												Sunny
a.m.	+8.0		-7.0		-2.5												
p.m.	13.5	13.5	-2.5	-7.0	13.5												Sunny
a.m.	13.5		-2.0		-0.5												
p.m.	19.5	20.0	-0.5	-2.0	19.5												Sunny
a.m.	20.0		3.0		5.0												
p.m.	23.0	23.0	5.0	3.0	23.0												Sunny
a.m.	23.0		5.0		6.5												
p.m.	18.0	18.0	6.5	5.0	18.0												
a.m.	19.0		2.0		4.0												
p.m.	13.0	13.0	4.0	2.0	10.0	0.2	0.2			0.2	1600	1900					Cloudy, Rain
a.m.	10.0		2.0		3.0												
p.m.	9.5	11.0	3.0	2.0	9.5												
a.m.	11.0		5.0		5.0	2.4					0600	0800					
p.m.	5.0	5.0	4.5	4.5	5.0	7.4	9.6			9.6	0800	1200					Rain
a.m.	5.0		1.0		1.5												
p.m.	[illegible]	9.5	1.5	1.0	9.5												Sun+Cloud
a.m.	9.5		-2.5		-0.5												
p.m.	11.0	11.0	-0.5	-2.5	11.0	3.0	3.0			3.0	2000	2300					Rain
a.m.	11.0		-1.0		-0.5												
p.m.	1.5	1.5	-0.5	-1.0	1.0	0.6	0.6			0.6	1300	1800					Snow/Rain
a.m.	1.0		-1.0		-0.5												
p.m.	3.0	3.0	-0.5	-1.0	3.0	T											Rain
a.m.	3.0		-0.5		0.0	T											
p.m.	4.0	4.0	0.0	0.0	4.0												
a.m.	4.0		-2.0		-2.0												
p.m.	11.0	11.0	-2.0	-2.0	11.0												Sunny
a.m.	11.0		-1.0		1.0												
p.m.	15.5	15.5	1.0	-1.0	15.5												Sunny
a.m.	15.5		4.0		5.5												
p.m.	15.0	15.5	5.5	4.0	15.0												Sunny
a.m.	15.5		+3.5		10.0												
p.m.	17.0	17.5	10.0	3.5	17.0												Sunny
a.m.	17.5		5.5		9.5												
p.m.	18.5	18.5	9.5	5.5	18.5												
a.m.	18.5		5.5		7.5						0900	1000					
p.m.	13.0	13.0	7.0	5.5	12.5	0.5	0.5			0.5							Shower
a.m.	12.5		3.5		4.0												
p.m.	9.0	9.5	4.0	3.5	9.0												
a.m.																	
p.m.																	
a.m.	9.5										Total no. of days with						
AS		316		7.5			13.9		20	15.3							
ANS		10.5		0.3													

TEMPERATURE EXTREMES
Maximum 23 Date 14th
Minimum -7.0 Date 12th

TEMPERATURE
Mean Max. 10.5
Mean Min. 0.3
Mean 5.4

Atmospheric Environment Service
Service de l'environnement atmosphérique

CLIMATOLOGICAL STATION REPORT

STATION 2089A 1162427-267 GC
DENISON PLANT SITE

of observation 8 a.m. 4 p.m.

T ☐
P ☐

PROVINCE B.C.

rver S. Hilts

MONTH May 1988

(158)

OBSERVATION	TEMPERATURE (°C) Maximum Observed 3	Maximum For Day 4	Minimum Observed 5	Minimum For Day 6	AFTER RESET 7	PRECIPITATION Rain Measured mm 8	Rain For Day mm 9	Snow Measured cm 10	Snow For Day cm 11	Total For Day mm 12	TIMES OF PRECIPITATION (Calendar Day) Began 13	Ended 14	Depth of Snow on Ground whole cm 15	Weather (Calendar Day) Thunderstorm 16	Freezing Rain 17	Hail 18	REMARKS 19
m.			2.5		3.0												
.m.	9.0	9.0	3.0	2.5	9.0												
.m.	9.0		-2.5		0.0												
.m.	9.0	10.0	0.0	-2.5	9.0												Cloudy
.m.	10.0		-2.0		2.5												
.m.	10.5	11.0	2.5	-2.0	10.5												Sunny A.M., Cloudy P.M.
.m.	11.0		-1.0		3.5												
.m.	10.0	11.0	3.5	-1.0	10.0												Sunny
a.m.	11.0		2.5		3.5												
.m.	4.5	5.5	3.5	2.5	4.5												Cloudy
a.m.	5.5		2.5		4.0												
.m.	12.0	15.0	4.0	2.5	12.0												Cloudy
a.m.	15.0		-1.0		2.0												
.m.	18.0	19.0	2.0	-1.0	18.0												Sunny
a.m.	19.0		9.5		12.0												
p.m.	20.0	20.5	12.0	9.5	20.0												Sunny
a.m.	20.5		7.0		9.5												
p.m.	22.0	22.5	9.5	7.0	22.0												Sunny
a.m.	22.5		12.0		14.5												
p.m.	20.0	20.5	14.5	12.0	20.0												
a.m.	20.5		10.0		15.5												
p.m.	20.5	21.0	15.5	10.0	20.5												Sunny
a.m.	21.0		7.0		11.5												
p.m.	24.5	25.0	11.5	7.0	24.5												Sunny
a.m.	25.0		7.5		11.5												
p.m.	16.5	16.5	11.5	7.5	11.5	0.2	0.2			0.2	0800	0900					Cloudy
a.m.	11.5		6.5		7.0												
p.m.	13.0	14.0	7.0	6.5	13.0	0.8	0.8			0.8	1080	1300					Cloudy
a.m.	14.0		0.0		5.0												
p.m.	16.0	16.0	5.0	0.0	16.0												Cloudy
a.m.	16.0		4.5		7.5												
p.m.	14.0	14.0	7.5	4.5	14.0	2.0	2.0			2.0	1200	1700					Cloudy
a.m.	14.0		0.5		7.0												
p.m.	11.5	11.5	7.0	0.5	10.5												Cloudy, Windy
a.m.	10.5		2.0		6.0												
p.m.	13.0	13.0	6.0	2.0	13.0												Sunny
a.m.	13.0		4.5		7.0												
p.m.	12.5	12.5	7.0	4.5	12.5												
a.m.	12.5		2.5		8.0												
p.m.	12.5	14.0	8.0	2.5	12.5												
a.m.	14.0		4.0		6.0												
p.m.	20.0	20.0	5.5	4.0	19.5												
a.m.	19.5		9.0		9.5												
p.m.	20.0	20.5	9.5	9.0	20.0	0.6	0.6			0.6							Time uncertain
a.m.	20.5		9.0		9.0												
p.m.	10.0	10.0	9.0	9.0	10.0												
a.m.	10.0		4.0		8.0												
p.m.	16.0	16.0	8.0	4.0	16.0												
a.m.	16.0		1.5		6.5												
p.m.	16.5	16.5	6.5	1.5	16.5												
a.m.	16.5		1.0		5.5												
p.m.	15.0	15.5	5.5	1.0	15.0												
a.m.	15.5		5.0		9.0												
p.m.	15.0	17.5	9.0	5.0	15.0												
a.m.	17.5		7.0		8.0												
p.m.	15.0	16.0	8.0	7.0	15.0	0.2	0.2			0.8							Time uncertain
a.m.	16.0		7.0		8.5												
p.m.	13.0	13.0	8.5	7.0	13.0												
a.m.	13.0		1.0		9.5												
p.m.	16.0	16.0	9.5	1.0	16.0												
a.m.	16.0		1.0		6.0												
p.m.	15.5	15.5	6.0	1.0	15.5	1.0	1.0			1.0							
a.m.	15.5										Total no. of days with						
MS		478		124			48			48							
ANS		15.4		4.0													

TEMPERATURE EXTREMES
Maximum 25.0 Date 12
" -2.5 " 2

TEMPERATURE
Mean Max. 15.4
Mean Min 4.0
" 9.7

CLIMATOLOGICAL STATION REPORT

Time of observation 8 a.m. 4 p.m.

T ☐
P ☐

Observer S. HILTS

STATION 2089R 1182427-267 BC
DENISON PLANT SITE

PROVINCE

MONTH MARCH 1980

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Day of Month	Time of Observation	Temperature (°C) Maximum Observed	Maximum For Day	Minimum Observed	Minimum For Day	After Reset	Rain Measured mm	Rain For Day mm	Snow Measured cm	Snow For Day cm	Total For Day W.E. mm	Times of Precipitation Began	Ended	Depth of Snow on Ground whole cm	Thunderstorm	Freezing Rain	Hail	Remarks
1	a.m.			4.0		4.5												
	p.m.	7.0	7.0	4.5	4.0	6.0												
2	a.m.	6.0		4.5		4.5								6				
	p.m.	12.0	12.0	4.5	4.5	12.0												
3	a.m.	12.0		-4.5		-4.5								5				
	p.m.	13.0	13.0	-5.0	-5.0	12.5												
4	a.m.	12.5		-5.0		-5.0								*				
	p.m.	9.0	9.0	-5.0	-5.0	9.0												
5	a.m.	9.0		2.0		2.5								*				
	p.m.	8.5	8.5	2.5	2.0	8.5												
6	a.m.	8.5		1.0		1.0								0				
	p.m.	3.0	3.0	1.0	1.0	3.0												
7	a.m.	3.0		-3.0		-3.0								0				
	p.m.	-1.5	-1.0	-3.0	-3.0	-1.5												
8	a.m.	-1.0		-4.5		-4.0			7.0	18.0	18.5			0				
	p.m.	-2.5	-2.5	-4.0	-4.5	-3.0			2.0									
9	a.m.	-3.0		-13.0		-11.5								17				
	p.m.	1.0	1.0	-11.0	-13.0	1.0												
0	a.m.	1.0		-5.5		-5.5				5.0				14				
	p.m.	0.0	0.0	-5.5	-5.5	0.0			5.0									SNOWFALL DEPTH AND
1	a.m.	0.0		-6.5		-6.5			0.5	0.5				*				PARTITIONING APPROXIMATED
	p.m.	3.0	3.0	-7.0	-7.0	2.0												
2	a.m.	3.0		-7.5		-2.5					3.9			*				
	p.m.	2.5	3.5	-2.5	-7.5	2.5												3.9 mm Water Equivalent measured
3	a.m.	3.5		0.5		0.5								15				MONDAY MORNING
	p.m.	7.5	7.5	0.5	0.5	7.5												
4	a.m.	7.5		1.5		2.5								14				
	p.m.	6.0	6.0	2.5	1.5	4.5												
5	a.m.	4.5		-2.5		-1.0								11				
	p.m.	5.5	5.5	-1.0	-2.5	5.5												
6	a.m.	5.5		-1.5		0.5				6	3.5			8				
	p.m.	2.5	2.5	-0.5	-1.5	2.5			6			?	0800					
7	a.m.	3.0		-8.5		-7.5			3	3	2.5			13				
	p.m.	7.0	7.0	-8.5	-8.5	7.0												
18	a.m.	7.0		-2.0		4.0								*				
	p.m.	9.0	9.0	4.0	-2.0	8.0												
19	a.m.	8.0		3.0		-3.5								*				
	p.m.	3.5	3.5	-1.5	-1.5	-1.5												
0	a.m.	-1.5		-14.5		-14.0			T	7.0	5.8	1500		7				
	p.m.	-10.0	-9.0	-14.0	-14.5	-10.0			7.0				to 0800					
1	a.m.	-9.0		-17.5		-17.5			1.0	5.0	4.6	1300	1500	11				
	p.m.	-7.0	-7.0	-17.5	-17.5	-7.5			4.0			2030	?					
2	a.m.	-7.5		-18.5		-17.0				T				15				
	p.m.	-7.5	-7.0	-17.0	-18.5	-7.5			T									
3	a.m.	-7.0		-21.5		-20.0								12				
	p.m.	0.0	1.5	-20.0	-21.5	0.0												
4	a.m.	1.5		-5.0		-5.0								10				
	p.m.	6.5	7.0	-5.0	-5.0	6.5												
5	a.m.	7.0		-8.5		-8.0								*				
	p.m.	8.0	9.0	-8.5	-8.5	8.0												
6	a.m.	9.0		3.0		5.5								*				
	p.m.	5.5	6.0	3.5	3.0	5.5												
7	a.m.	6.0		-1.0		0.0			T	T				3				
	p.m.	10.5	10.5	0.0	-1.0	10.5												
8	a.m.	6.5		3.0		6.5								2				
	p.m.	9.5	9.5	5.0	3.0	9.0												
9	a.m.	9.5		6.0		6.5								0				
	p.m.	10.0	11.0	6.5	6.0	10.0												
0	a.m.	11.0		3.0		4.0								0				
	p.m.	8.5	9.0	3.5	3.0	8.0												
1	a.m.	9.0		0.5		0.5		1.6			1.6	1920	2030	0				
	p.m.	8.5	8.5	0.5	0.5	8.5	1.6											
	a.m.	8.5												0				
SUMS			147		-124			1:6		44.5	40.4	Total no. of days with						
MEANS			4.7		-4.0													

TEMPERATURE EXTREMES
Maximum 13 Date 3
Minimum -21.5 Date 23

TEMPERATURE
Mean Max. 4.7
Mean Min. -4.0
Mean 0.4

Time of observation 8 a.m. 4 p.m.

I P

PROVINCE PLANT SITE.

Observer S. HILTS

MONTH APRIL 1990

(159)

DAY OF MONTH	TIME OF OBSERVATION	TEMPERATURE (°C) Maximum Observed 3	Maximum For Day 4	Minimum Observed 5	Minimum For Day 6	AFTER RESET 7	PRECIPITATION Rain Measured 8 mm	Rain For Day 9 mm	Snow Measured 10 cm	Snow For Day 11 cm	Total For Day W.E. 12 mm	TIMES OF PRECIPITATION (Calendar Day) Began 13	Ended 14	Depth of Snow on Ground whole cm 15	Weather (Calendar Day) Thunderstorm 16	Freezing Rain 17	Hail 18	REMARKS 19
1	a.m.			0.0		1.0								0				
	p.m.	13.0	13.5	1.0	0.0	13.0		1.8			1.8	2100						
2	a.m.	13.5		2.0		2.0	1.8						0130	0				
	p.m.	8.0	8.0	2.0	2.0	8.0												
3	a.m.	8.0		2.0		3.0								0				
	p.m.	9.5	9.5	3.0	2.0	9.0												
4	a.m.	9.0		-3.0		-2.0								0				
	p.m.	9.5	9.5	-2.0	-3.0	9.5												
5	a.m.	9.5		-5.0		0.0								0				
	p.m.	13.0	13.0	0.0	-5.0	12.5												
6	a.m.	12.5		-1.5		0.5								0				
	p.m.	8.0	8.0	0.0	-1.5	8.0												
7	a.m.	8.0		-5.0		-4.5								*				SNOW DISTRIBUTION ESTIMATED
	p.m.	5.0	5.0	-4.5	-5.0	4.0				5.5	5.5	1600	?					
8	a.m.	4.0		-12.5		-12.5			5.5					*				
	p.m.	-4.5	-3.0	-13.0	-13.0	-4.5				3.0	3.0	1800	2100					
9	a.m.	-3.0		-11.0		-10.0			3.0					6				8.5mm SNOW W.E. MEASURE MONDAY MORNING
	p.m.	-1.5	-1.5	-10.0	-11.0	-1.5												
10	a.m.	-1.5		-15.0		-11.5								4				
	p.m.	8.0	8.0	-11.5	-15.0	6.0												
11	a.m.	6.0		-7.0		-5.0								1				
	p.m.	10.5	11.0	-5.0	-7.0	10.5				T	T							
12	a.m.	11.0		0.0		0.0			T			?	0730	0				
	p.m.	3.0	4.5	0.0	0.0	3.0			T	T	T							
13	a.m.	4.5		-2.0		2.0								0				
	p.m.	10.0	10.0	2.0	-2.0	9.5												
14	a.m.	9.5		3.0		5.5								0				
	p.m.	13.5	13.5	5.5	3.0	13.5												
15	a.m.	13.5		3.0		3.0								0				
	p.m.	3.0	4.5	0.5	0.5	3.0												
16	a.m.	4.5		-5.5		-5.5								0				
	p.m.	15.5	16.0	-5.5	-5.5	15.5												
17	a.m.	16.0		-2.0		1.0								0				
	p.m.	17.5	17.5	1.0	-2.0	16.0												
18	a.m.	16.0		5.0		7.5								0				
	p.m.	13.0	13.0	7.5	5.0	11.5		0.2			0.2							
19	a.m.	11.5		3.0		5.0	0.2					0730	0800	0				
	p.m.	12.5	12.5	5.0	3.0	11.0	0.2	0.8			0.8	0900	0930					
20	a.m.	11.0		2.5		6.0	0.6					0100	0200	0				
	p.m.	12.5	13.0	6.0	2.5	12.5												
21	a.m.	13.0		1.0		3.0								0				
	p.m.	11.5	11.5	3.0	1.0	11.0												
22	a.m.	11.0		2.5		3.0								0				
	p.m.	11.0	11.5	3.0	2.5	11.0												
23	a.m.	11.5		1.0		2.5								0				
	p.m.	14.0	14.0	2.5	1.0	14.0		11.2			11.2	2210						
24	a.m.	14.0		3.5		3.5	11.2						0800	0				
	p.m.	7.5	8.0	3.5	3.5	7.5	3.5	3.5			3.5	0900	1030					
25	a.m.	8.0		-0.5		1.5	T							0				
	p.m.	7.0	7.0	1.5	-0.5	4.0	0.4	0.4			0.4	1500	1530					
26	a.m.	4.0		-3.5		-3.0	T							0				
	p.m.	0.5	0.5	-3.0	-3.5	0.0	T	T										
27	a.m.	0.0		-2.5		-2.0	T							0				
	p.m.	0.5	0.5	-2.0	-2.5	0.0			0.4	1.2	1.2							
28	a.m.	0.0		-4.0		-3.5			0.8					0				
	p.m.	1.0	1.5	-3.5	-4.0	1.0												
29	a.m.	1.5		-4.0		-1.0								0				
	p.m.	12.0	12.5	-1.0	-4.0	12.0												
30	a.m.	12.5		-1.5		1.5								0				
	p.m.	16.0	16.5	1.5	-1.5	16.0												
31	a.m.																	
	p.m.																	
1	a.m.	16.5										Total no. of days with			-	-	-	
SUMS			269.0		-60.0			17.9		9.7	25.8							
MEANS			9.0		-2.0													

TEMPERATURE EXTREMES

Maximum 17.5 Date 17th

Minimum -15.0 Date 10th

TEMPERATURE

Mean Max. 9.0

Mean Min -2.0

Mean 3.5

DIGITIZED PROFILE RECORDS

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 1
MINE : FCL
DUMP DESIGNATION : BROWNIE SPOIL - F GULLY
FAILURE DATE : 11 JUN. 1983

COMPUTER FILES
123 : 1COOR.WK1
GRAPHER
GRAPH : 1SECT
NAT. G. SURFACE : 1GS.DAT
DUMP SURFACE : 1SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
50	2280
75	2260
100	2240
125	2220
150	2200
175	2180
205	2160
235	2140
280	2120
315	2100
365	2080
410	2060
460	2040
505	2020
565	2000
615	1980
690	1960
760	1940
840	1920
920	1900
950	1895

DUMP SURFACE COORDINATES (m)	
X	Y
0	2318
50	2318
365	2080

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	:	3
MINE	:	FCL
DUMP DESIGNATION	:	BROWNIE GULLY D-E
FAILURE DATE	:	12 SEPT 84

COMPUTER FILES

123	:	3COOR.WK1
GRAPHER		
GRAPH	:	3SECT
NAT. G. SURFACE	:	3GS.DAT
DUMP SURFACE	:	3SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	2305	
30	2280	
62	2260	
88	2240	
120	2220	
145	2200	
170	2180	
195	2160	
232	2140	
273	2120	
310	2100	
340	2087	
360	2080	
400	2060	
448	2040	
495	2020	
554	2000	
620	1980	
690	1960	
792	1940	
864	1920	
948	1900	
970	1897	END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	2305
55	2305
340	2087

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	:	6
MINE	:	FCL
DUMP DESIGNATION	:	BROWNIE SPOIL
FAILURE DATE	:	16 AUG. 1985

COMPUTER FILES

123	:	6COOR.WK1
GRAPHER		
GRAPH	:	6SECT
NAT. G. SURFACE	:	6GS.DAT
DUMP SURFACE	:	6SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2280
15	2260
25	2240
45	2220
68	2200
99	2180
128	2160
161	2140
195	2120
235	2100
285	2080
325	2060
375	2040
452	2020
532	2000
622	1980
735	1960
845	1940
920	1920
950	1919

DUMP SURFACE COORDINATES (m)	
X	Y
5	2275
52	2275
335	2060

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 7
MINE : FORDING COAL LTD
DUMP DESIGNATION : BROWNIE G SPOIL
FAILURE DATE : 29 JUNE 1985

COMPUTER FILES
123 : 7COOR.WK1
GRAPHER
GRAPH : 7SECT
NAT. G. SURFACE : 7GS.DAT
DUMP SURFACE : 7SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2292
12	2280
40	2260
65	2240
100	2220
133	2200
162	2180
187	2160
215	2140
242	2120
280	2100
325	2080
355	2060
389	2040
443	2020
500	2000
540	1980
568	1960
602	1940

DUMP SURFACE COORDINATES (m)	
X	Y
0	2300
20	2300
285	2100

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 9
MINE : FCL, BLAINE PIT
DUMP DESIGNATION : #2 SPOIL
FAILURE DATE : 30 JAN 1984

COMPUTER FILES
123 : 9COOR.WK1
GRAPHER
GRAPH : 9SECT
NAT. G. SURFACE : 9GS.DAT
DUMP SURFACE : 9SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1825	
78	1797	
97	1789	
110	1785	
142	1775	
200	1763	
245	1750	
314	1737	
358	1728	
401	1720	
435	1714	
476	1704	
490	1716	END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	1970
77	1970
435	1714

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 11
MINE : FCL
DUMP DESIGNATION : BROWNIE GULLY G&H
FAILURE DATE : 16 SEP. 1985

COMPUTER FILES
123 : 11COOR.WK1
GRAPHER
GRAPH : 11SECT
NAT. G. SURFACE : 11GS.DAT
DUMP SURFACE : 11SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2270
24	2260
62	2240
82	2220
108	2200
130	2180
150	2160
180	2140
208	2120
244	2100
276	2080
304	2060
348	2040
386	2020
410	2005
420	2000
460	1980
470	1975
500	1960
542	1940
582	1920
618	1900
680	1880
770	1860
846	1840
965	1820

DUMP SURFACE COORDINATES (m)	
X	Y
0	2270
50	2270
410	2005

DSS - MINE WASTE RUN OUT STUDY
RUN OUT SECTION DATA FILE

P91-1209

DATA BASE FILE NUMBER : 12
MINE : FCL
DUMP DESIGNATION : 13 SEAM ALTERNATE
FAILURE DATE : 14 AUG. 1986

COMPUTER FILES
123 : 12COOR.WK1
GRAPHER
GRAPH : 12SECT
NAT. G. SURFACE : 12GS.DAT
DUMP SURFACE : 12SS.DAT
TOP OF DEBRIS : 12TD.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2330
8	2320
42	2300
60	2280
76	2260
100	2240
113	2220
143	2200
169	2180
208	2160
220	2150
236	2140
267	2120
304	2100
362	2080
395	2072
455	2068
480	2068
545	2072
600	2068

DUMP SURFACE COORDINATES (m)	
X	Y
0	2330
10	2330
220	2150

TOP SURFACE OF FAILURE DEBRIS COORDINATES (M)	
X	Y
167	2285
175	2270
195	2255
215	2240
235	2225
255	2210
278	2195
299	2180
320	2165
345	2150
550	2135

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 14
MINE : FCL
DUMP DESIGNATION : BLACKSTONE EMERGENCY DUMP
FAILURE DATE : 5 OCT. 1986

COMPUTER FILES
123 : 14COOR.WK1
GRAPHER
GRAPH : 14SECT
NAT. G. SURFACE : 14GS.DAT
DUMP SURFACE : 14SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2300
26	2280
55	2260
83	2240
113	2220
142	2200
171	2180
202	2160
233	2140
265	2120
300	2100
340	2080
381	2060
413	2040
456	2020
510	2000
570	1980
612	1960
675	1940
728	1920
818	1900
871	1880
943	1860
1012	1840
1105	1820
1188	1804
1200	1800
1255	1788

DUMP SURFACE COORDINATES (m)	
X	Y
0	0
0	0
0	0
0	0

SURFACE OF FAILURE DEBRIS COORDINATES (M)	
X	Y
520	2000
592	1970
680	1940
725	1925
790	1910
875	1895
965	1880
1020	1865
1065	1850
1100	1835
1155	1820
1215	1805
1295	1790

DSS – MINE WASTE RUN OUT STUDY P91–1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 16
MINE : FCL
DUMP DESIGNATION : BLACKRILL SPOIL
FAILURE DATE : 17 JUN. 1985

COMPUTER FILES
123 : 16COOR.WK1
GRAPHER
GRAPH : 16SECT
NAT. G. SURFACE : 16GS.DAT
DUMP SURFACE : 16SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	2270	
9	2260	
38	2240	
71	2220	
105	2200	
134	2180	
170	2160	
198	2140	
230	2120	
265	2100	
300	2080	
332	2060	
370	2040	
405	2020	
440	2000	
472	1980	
515	1960	
553	1940	
600	1920	
631	1900	TURN POINT
691	1880	
755	1860	
840	1840	
945	1820	
1085	1800	
1105	1795	END

DUMP SURFACE COORDINATES (m)	
X	Y
0	2270
34	2270
220	2130

DSS – MINE WASTE RUN OUT STUDY P91–1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 19
MINE : FORDING COAL LTD
DUMP DESIGNATION : CLODE SPOIL PILE
FAILURE DATE : MAY 05,1972

COMPUTER FILES
123 : 19COOR.WK1
GRAPHER
GRAPH : 19SECT
NAT. G. SURFACE : 19GS.DAT
DUMP SURFACE : 19SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
21	1928
37	1920
52	1913
64	1905
73	1897
88	1890
104	1882
119	1875
131	1867
143	1859
216	1829
305	1798
372	1768
482	1737
600	1707
655	1699
[illegible]	1692
725	1689

DUMP SURFACE COORDINATES (m)	
X	Y
0	1966
70	1966
274	1812

NAT. GR. SURFACE COORDINATES (ft)		
X	Y	
70	6325	
120	6300	
170	6275	
210	6250	
240	6225	
290	6200	
340	6175	
390	6150	
430	6125	
470	6100	
710	6000	
1000	5900	
1220	5800	BEND IN SECTION
1580	5700	
1970	5600	
2150	5575	
2330	5550	
2380	5540	

DUMP SURFACE COORDINATES (ft)		
X	Y	
0	6450	
230	6450	
900	5945	SLOPE=37DEG

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 20
MINE : FORDING COAL LTD
DUMP DESIGNATION : 2 SPOIL
FAILURE DATE : 20 MAY 1972

COMPUTER FILES
123 : 20COOR.WK1
GRAPHER
GRAPH : 20SECT
NAT. G. SURFACE : 20GS.DAT
DUMP SURFACE : 20SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	1968
30	1949
37	1945
55	1936
75	1926
101	1906
123	1890
183	1852
223	1833
238	1826
263	1814
274	1809
296	1802
322	1796
351	1788
396	1771
440	1754
493	1733
509	1728
543	1724
579	1716
596	1713
541	1754
440	1754
541	1754
596	1713
655	1705
671	1701
677	1701
695	1700

DUMP SURFACE COORDINATES (m)	
X	Y
0	1968
46	1968
223	1833

NAT. GR. SURFACE COORDINATES (ft)	
X	Y
0	6457
100	6395
120	6380
180	6352
246	6320
330	6252
405	6200
600	6077
733	6015
780	5990
864	5950
900	5935
970	5912
1057	5892
1152	5865
1300	5810
1445	5755
1618	5685
1670	5670
1780	5655
1900	5630
1955	5620
1775	5755
1445	5755
1775	5755
1955	5620
2150	5594
2200	5582
2220	5580
2280	5578

DUMP SURFACE COORDINATES (ft)	
X	Y
0	6457
150	6457
733	6015

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 24
MINE : FCL
DUMP DESIGNATION : CLODE CREEK
FAILURE DATE : 08 NOV. 1974

COMPUTER FILES
123 : 24COOR.WK1
GRAPHER
GRAPH : 24SECT
NAT. G. SURFACE : 24GS.DAT
DUMP SURFACE : 24SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	1947
45	1925
90	1900
145	1875
195	1850
260	1825
310	1800
355	1775
385	1755
400	1750
500	1725
550	1700
700	1685
825	1690
900	1687
935	1680

DUMP SURFACE COORDINATES (m)	
X	Y
0	1947
170	1947
385	1755

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	:	27
MINE	:	FCL
DUMP DESIGNATION	:	CLODE WASTE PILE
FAILURE DATE	:	12 NOV 1974

COMPUTER FILES

123	:	27COOR.WK1
GRAPHER		
GRAPH	:	27SECT
NAT. G. SURFACE	:	27GS.DAT
DUMP SURFACE	:	27SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1947	
40	1925	
90	1900	
130	1875	
175	1850	
230	1825	
305	1800	
380	1775	
440	1750	
510	1725	
525	1723	
680	1700	
750	1695	END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	1947
230	1947
525	1723

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	:	35
MINE	:	BLMR
DUMP DESIGNATION	:	HARMER II BRIDGE
FAILURE DATE	:	18 NOV 1980

COMPUTER FILES

123	:	35COOR.WK1
GRAPHER		
GRAPH	:	35SECT
NAT. G. SURFACE	:	35GS.DAT
DUMP SURFACE	:	35SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1750	
52	1737	
67	1731	
113	1725	
131	1719	
183	1713	
229	1701	
268	1676	
305	1646	
393	1615	
427	1609	
457	1612	
0	0	
0	0	
0	0	
0	0	
0	0	END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	1865
67	1865
354	1628

NAT. GR. SURFACE COORDINATES (ft)	
X	Y
0	5740
170	5700
220	5680
370	5660
430	5640
600	5620
750	5580
880	5500
1000	5400
1290	5300
1400	5280
1500	5290

DUMP SURFACE COORDINATES (ft)	
X	Y
0	6120
220	6120
1160	5340

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 36
MINE : WESTAR
DUMP DESIGNATION : ADIT 40-C1
FAILURE DATE : 29 JUN. 1982

COMPUTER FILES
123 : 36COOR.WK1
GRAPHER
GRAPH : 36SECT
NAT. G. SURFACE : 36GS.DAT
DUMP SURFACE : 36SS.DAT
TOP OF DEBRIS : 36TD.DAT

NAT.GR.SURFACE COORDINA X	Y	
0	1829	
52	1804	
183	1743	BEND
226	1736	
497	1622	
558	1585	BEND
576	1576	
594	1568	
670	1553	
750	1538	
835	1506	BEND
930	1484	
1027	1463	BEND IN SECTION
1125	1448	BEND IN SECTION
1207	1439	BEND IN SECTION
1280	1431	
1310	1426	BEND IN SECTION
1338	1423	
1408	1416	
1490	1408	

DUMP SURFACE COORDINATES (M) X	Y	
15	1823	
76	1823	SCARP
131	1823	CREST
183	1786	BEND
317	1698	TOE

TOP SURFACE OF FAILURE DEBRIS COORDINATES (M) X	Y
1125	1448
1189	1446
1329	1439
1372	1431
1402	1423
1436	1416
1490	1411

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 38
MINE : KAISER, ERICKSON CREEK
DUMP DESIGNATION : ADIT 29 SOUTH
FAILURE DATE : 08 FEB. 1976

COMPUTER FILES
123 : 38COOR.WK1
GRAPHER
GRAPH : 38SECT
NAT. G. SURFACE : 38GS.DAT
DUMP SURFACE : 38SS.DAT
TOP OF DEBRIS : 38TD.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1798	
46	1774	
107	1750	
146	1725	
165	1707	
235	1676	
296	1646	
360	1615	BEND IN SECTION
555	1585	BEND IN SECTION
634	1573	BEND IN SECTION
689	1567	BEND IN SECTION
789	1555	
853	1542	BEND IN SECTION
954	1535	TERMINUS

DUMP SURFACE COORDINATES (m)	
X	Y
0	1865
67	1865
409	1607

TOP SUR OF DEBRI COORDIN	
X	Y
409	1623
555	1601
634	1589
689	1583
789	1571
853	1558
954	1551

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 40
MINE : KAISER, BALMER PIT
DUMP DESIGNATION : NO. 2
FAILURE DATE : 24 NOV. 1968

COMPUTER FILES
123 : 40COOR.WK1
GRAPHER
GRAPH : 40SECT
NAT. G. SURFACE : 40GS.DAT
DUMP SURFACE : 40SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
171	1442	
219	1401	
256	1364	
305	1334	
352	1305	
433	1271	
488	1237	
539	1219	
671	1196	
689	1189	
744	1181	
768	1173	
788	1158	
823	1135	
838	1128	
881	1128	
1024	1128	END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	1463
171	1463
410	1283

NAT. GR. SURFACE COORDINATES (ft)	
X	Y
560	4730
720	4595
840	4475
1000	4375
1155	4280
1420	4170
1600	4060
1770	4000
2200	3925
2260	3900
2440	3875
2520	3850
2585	3800
2700	3725
2750	3700
2890	3700
3360	3700

DUMP SURFACE COORDINATES (ft)	
X	Y
0	4800
560	4800
720	4675
850	4585
1000	4468
1150	4370
1420	4200
1675	4100
1905	4020

DSS - MINE WASTE RUN OUT STUDY
RUN OUT SECTION DATA FILE

P91-1209

DATA BASE FILE NUMBER : 42
MINE : WESTAR BALMER
DUMP DESIGNATION : ADIT 29 N
FAILURE DATE : MAY 5,1971

COMPUTER FILES
- 123 : 42COOR.WK1
- GRAPHER
  - GRAPH : 42COOR.WK1
  - NAT. G. SURFACE : 42GS.DAT
  - DUMP SURFACE : 42SS.DAT
- TOP OF DEBRIS : 42TD.DAT

NAT. GR. SURFACE COORDIN		
X	Y	
0	2054	
107	2048	
177	2042	
213	2011	BEND IN S
274	1981	
320	1951	
381	1920	
433	1890	
518	1859	
560	1829	
594	1798	
634	1768	
707	1737	
777	1707	
853	1676	
1009	1646	
1076	1628	
1158	1615	
1274	1603	
1417	1585	
1555	1567	BEND IN SECTION
1676	1555	
1890	1536	
1969	1531	BEND IN SECTION
2134	1524	
2341	1512	BEND IN SECTION
2521	1506	
2597	1500	BEND IN SECTION
2728	1494	
2926	1487	
3005	1481	
3331	1475	TERMINUS

DUMP SURFACE COORDINA	
X	Y
0	2063
293	2063
750	1719

TOP OF DEBRIS SURFACE COORDINATES (M)	
X	Y
750	1719
988	1707
1112	1689
1204	1676
1286	1646
1387	1615
1448	1609
1509	1591
1573	1570
1881	1554
2103	1548
2301	1536
2462	1518
2560	1512
2728	1506
2926	1493
3057	1487
3200	1481
3331	1475

DSS - MINE WASTE RUN OUT STUDY
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 43
MINE : KAISER
DUMP DESIGNATION : HARMER KNOB
FAILURE DATE : 13 MAY 1071

COMPUTER FILES
123 : 43COOR.WK1
GRAPHER
GRAPH : 43SECT
TOP OF DEBRIS : 43TD.DAT
DUMP SURFACE : 43SS.DAT

TOP OF DEBRIS COORDINATES (m)		
X	Y	
0	2012	
94	1981	
152	1951	
197	1920	
268	1890	
314	1859	
375	1829	
433	1798	
506	1768	
564	1737	
649	1707	
713	1676	
767	1646	
856	1615	
988	1585	
1100	1554	
1241	1524	
1420	1494	
1530	1463	
1768	1433	
1890	1402	
1966	1384	
2033	1372	
2313	1341	
2399	1311	
2521	1311	
2612	1280	
2752	1250	
2929	1219	
3206	1189	
3420	1158	
3480	1154	END OF FAILURE
3577	1146	

DUMP SURFACE COORDINATES (m)	
X	Y
0	2012
108	2012
314	1859

TOP OF DEBRIS SURFACE COORDINATES (ft)	
X	Y
0	6600
310	6500
500	6400
645	6300
880	6200
1030	6100
1230	6000
1420	5900
1660	5800
1850	5700
2130	5600
2340	5500
2515	5400
2810	5300
3240	5200
3610	5100
4070	5000
4660	4900
5020	4800
5800	4700
6200	4600
6450	4540
6670	4500
7590	4400
7870	4300
8270	4300
8570	4200
9030	4100
9610	4000
10520	3900
11220	3800
11735	3760

DUMP SURFACE COORDINATES (ft)	
X	Y
0	6600
355	6600
1030	6100

DSS – MINE WASTE RUN OUT STUDY P91–1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 44
MINE : KAISER, BALMER PIT
DUMP DESIGNATION : ADIT 29 S 6380
FAILURE DATE : 25 MAY 1973

COMPUTER FILES
123 : 44COOR.WK1
GRAPHER
GRAPH : 44SECT
NAT. G. SURFACE : 44GS.DAT
DUMP SURFACE : 44SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1914	
213	1859	
274	1829	
329	1798	
357	1786	
402	1768	
494	1737	
539	1725	
585	1707	
655	1670	
768	1640	
879	1615	
945	1609	
1030	1591	
1128	1573	
1207	1558	
1326	1548	
1396	1542	
1630	1524	
1768	1515	
1878	1509	
1996	1500	
2088	1494	
2198	1487	
2323	1481	
2417	1475	
2749	1463	
2862	1457	
3011	1451	TERMINUS

DUMP SURFACE COORDINATES (m)		
X	Y	
97	1945	
226	1945	
510	1731	TOE

DSS - MINE WASTE RUN OUT STUDY 91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 48
MINE : QUINTETTE
DUMP DESIGNATION : 1640 MM
FAILURE DATE : 21 JUNE 86

COMPUTER FILES
123 : 48COOR.WK1
GRAPHER
GRAPH : 48SECT
NAT. G. SURFACE : 48GS.DAT
DUMP SURFACE : 48SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1585	
35	1570	
80	1550	
145	1525	
210	1500	
257	1480	
285	1470	
295	1460	
312	1455	
330	1450	
380	1435	
405	1425	
412	1420	
440	1410	
465	1400	
505	1395	BREAKPOINT IN SECTION
555	1390	
580	1385	
615	1375	
655	1370	BREAKPOINT IN SECTION
695	1365	
810	1350	TERMINUS

DUMP SURFACE COORDINATES (m)	
X	Y
0	1640
112	1640
405	1423

EXISTING DEBRIS PRIOR TO FAILURE ALONG RUNOUT PATH COORDINATES (M)		
X	Y	
420	1415	
470	1410	
515	1410	
525	1405	
537	1400	
575	1395	
585	1390	
610	1380	
640	1375	
655	1370	
710	1365	
735	1360	
810	1355	TERMINUS

DATA BASE FILE NUMBER : 49
MINE : QUINTETTE
DUMP DESIGNATION : 1705 W/N
FAILURE DATE : 30 JUNE 1986

COMPUTER FILES
123 : 49COOR.WK1
GRAPHER
GRAPH : 49SECT TOP OF DEBRIS: 49 TD.DAT
NAT. G. SURFACE : 49GS.DAT
DUMP SURFACE : 49SS.DAT
BOTTOM OF RUNOUT : 49BR.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1655	
140	1625	
210	1600	
255	1575	
270	1560	
340	1540	
400	1525	
475	1500	
525	1475	
550	1467	BREAK IN SECTION
580	1465	
615	1450	
670	1425	
760	1400	
860	1375	
940	1360	
1060	1345	
1130	1337	BREAK IN SECTION
1170	1330	
1280	1315	
1390	1300	
1510	1275	

DUMP SURFACE COORDINATES (m)		
X	Y	
0	1705	
200	1705	CREST
472	1500	TOE

EXISTING DEBRIS PRIOR TO FAILURE ALONG RUNOUT PATH COORDINATES (M)	
X	Y
210	1600
215	1600
255	1580
340	1545
400	1530
475	1505
475	1500

TOP SURFACE OF DEBRIS COORDINATES (M)	
X	Y
590	1460
650	1440
690	1435
710	1430
760	1410
805	1385
875	1370
1005	1350
1130	1335
1180	1325
1180	1320
1410	1295
1450	1285
1570	1270
1630	1260
1645	1255
1785	1245
1865	1230
1980	1225
2080	1220

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 54
MINE : QUINTETTE
DUMP DESIGNATION : 1660 N DUMP
FAILURE DATE : 07 SEP 1985

COMPUTER FILES
123 : 54COOR.WK1
GRAPHER
GRAPH : 54SECT
NAT. G. SURFACE : 54GS.DAT
DUMP SURFACE : 54SS.DAT
TOP OF DEBRIS : 54TD.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1660	
70	1635	
195	1600	
295	1550	
420	1500	
434	1480	
510	1450	
535	1445	
560	1430	
620	1420	
720	1400	
815	1375	
935	1350	
1010	1340	
1100	1325	
1285	1300	
1460	1275	
1590	1265	
1715	1260	
1820	1240	
2025	1210	
2125	1190	
2330	1175	
2480	1165	
2610	1160	
2800	1145	END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	1660
335	1660
627	1418

TOP OF DEBRIS SURFACE COORDINATES (M)	
X	Y
720	1418
935	1377
1285	1294
1820	1237
2125	1211
2330	1190
2610	1165
2800	1147

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 62
MINE : LINE CREEK
DUMP DESIGNATION : 1996 DUMP
FAILURE DATE : 01 JULY 1982

COMPUTER FILES
123 : 62COOR.WK1
GRAPHER
GRAPH : 62SECT
NAT. G. SURFACE : 62GS.DAT
DUMP SURFACE : 62SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1975	
25	1940	
80	1900	
160	1850	
235	1824	
268	1800	
295	1790	
330	1780	
360	1760	
420	1750	
500	1740	
570	1730	
635	1720	
695	1710	
745	1700	
840	1690	
900	1680	
970	1670	
1035	1660	
1120	1650	
1200	1640	
1300	1630	
1355	1620	
1440	1610	
1500	1600	
1610	1590	
1715	1580	
1810	1570	
1900	1560	
1985	1550	
2070	1540	
2170	1530	
2255	1520	END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	1966
35	1966
235	1824

DSS – MINE WASTE RUN OUT STUDY P91–1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 74
MINE : WESTAR GREENHILLS
DUMP DESIGNATION : NORTH DUMP 2100
FAILURE DATE : 7 SEPT 1986

COMPUTER FILES
123 : 74COOR.WK1
GRAPHER
GRAPH : 74SECT
NAT. G. SURFACE : 74GS.DAT
DUMP SURFACE : 74SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	2100	
27	2075	
62	2050	
100	2025	
130	2000	
165	1975	
200	1950	
232	1925	
282	1900	
322	1875	
345	1870	
395	1850	
435	1837	BOTTOM OF CREEK CHANNEL
455	1845	
495	1850	
515	1850	
528	1855	
540	1860	
555	1865	TERMINUS
587	1875	
630	1900	

DUMP SURFACE COORDINATES (m)	
X	Y
0	2100
90	2100
290	1950
422	1850

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	:	75
MINE	:	WESTAR GREENHILLS
DUMP DESIGNATION	:	HAWK PIT DUMP
FAILURE DATE	:	20 MAR. 1983

COMPUTER FILES

123	:	75COOR1.WK1
GRAPHER		
GRAPH	:	75SECT1
NAT. G. SURFACE	:	75GS1.DAT
DUMP SURFACE	:	75SS1.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
158	2100
195	2075
242	2050
285	2025
321	2000
373	1950
436	1950
503	1925
561	1900
615	1875
703	1850
751	1825
848	1800
897	1787
1024	1787
1048	1800

DUMP SURFACE COORDINATES (m)	
X	Y
0	2160
80	2160
320	1995

DSS – MINE WASTE RUN OUT STUDY P91–1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 75
MINE : WESTAR GREENHILLS
DUMP DESIGNATION : HAWK PIT DUMP
FAILURE DATE : 20 MAR. 1983

COMPUTER FILES
123 : 75COOR2.WK1
GRAPHER
GRAPH : 75SECT2
NAT. G. SURFACE : 75GS2.DAT
DUMP SURFACE : 75SS2.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2160
66	2150
99	2125
133	2100
169	2075
215	2050
267	2025
316	2000
374	1975
466	1950
538	1925
617	1900
699	1875
794	1850
863	1825
915	1800
1020	1787
1097	1787
1153	1800

DUMP SURFACE COORDINATES (m)	
X	Y
0	2160
80	2160
320	1995

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 76
MINE : WESTAR GREENHILLS
DUMP DESIGNATION : 2200 EAST DUMP
FAILURE DATE : 11 MAY 1983

COMPUTER FILES
123 : 76COOR.WK1
GRAPHER
GRAPH : 76SECT
NAT. G. SURFACE : 76GS.DAT
DUMP SURFACE : 76SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2180
80	2150
130	2125
202	2100
312	2075
425	2050
500	2030
510	2025
705	2000
895	1975

DUMP SURFACE COORDINATES (m)	
X	Y
0	2200
197	2200
500	2030

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	:	**79**
MINE	:	**GREENHILLS**
DUMP DESIGNATION	:	**EAST 2140**
FAILURE DATE	:	**12 JULY 1986**

COMPUTER FILES

123	:	**79COOR.WK1**
GRAPHER		
GRAPH	:	**79SECT**
NAT. G. SURFACE	:	**79GS.DAT**
DUMP SURFACE	:	**79SS.DAT**

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2125
25	2113
58	2090
325	1987.5
380	1975
405	1972.5
460	1962.5
510	1950
655	1937.5
680	1935
800	1925
825	1937.5
850	1945

DUMP SURFACE COORDINATES (m)	
X	Y
0	2145
25	2145
58	2145
325	1987.5

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	:	80
MINE	:	GREENHILLS
DUMP DESIGNATION	:	EAST 2140 DUMP
FAILURE DATE	:	12 FEB 1987

COMPUTER FILES

123	:	80COOR1.WK1	SECTION A-B
GRAPHER			
GRAPH	:	80SECT1	
NAT. G. SURFACE	:	80GS1.DAT	
DUMP SURFACE	:	80SS1.DAT	
BOTTOM OF RUNOUT	:	80BR1.DAT	

NAT. GR. SURFACE COORDINATES (m)

X	Y	
0	2135	
35	2125	
130	2100	
180	2075	
230	2050	
270	2025	
330	2000	
395	1975	
475	1975	
580	1975	
640	1962	
460	1950	
700	1925	
760	1900	
805	1890	CREEK
840	1900	
865	1915	

DUMP SURFACE COORDINATES (m)

X	Y
0	2144
108	2144
285	2012.5

EXISTING DEBRIS PRIOR TO FAILURE ALONG RUNOUT PATH

X	Y	
285	2012.5	
327	2000	
366	1987.5	
408	1975	
517	1962.5	
548	1950	
610	1937.5	
653	1925	
703	1912.5	
743	1900	
798	1887.5	
847	1887.5	
860	1895	TERMINUS

DSS – MINE WASTE RUN OUT STUDY 91–1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 80
MINE : GREENHILLS
DUMP DESIGNATION : EAST 2140 DUMP
FAILURE DATE : 12 FEB 1987

COMPUTER FILES
123 : 80COOR2.WK1 SECTION C-G
GRAPHER
GRAPH : 80SECT2
NAT. G. SURFACE : 80GS2.DAT
DUMP SURFACE : 80SS2.DAT
BOTTOM OF RUNOUT : 80BR2.DAT

NAT.GR.SURFACE COORDINA		
X		
0	2130	
10	2125	
77	2100	
145	2075	
210	2050	
254	2025	
323	2000	
390	2075	
470	2050	
510	2040	
595	1925	
730	1900	
832	1890	CREEK
875	1900	
925	1925	
975	1950	POINT G

DUMP SURFACE COORDINA		
X	Y	
0	2144	
92	2144	SCARP
124	2144	
320	2000	

EXISTING DEBRIS PRIOR TO FAILURE ALONG R OUT PATH		
X	Y	
367	1987.5	
420	1987.5	
468	1962.5	
510	1957.5	POINT D
537	1950	
595	1940	POINT E
612	1937.5	
674	1925	
726	1912.5	
732	19100	POINT F
773	1900	
823	1887.5	
850	1887.5	
883	1895	TERMINUS
891	1900	
914	1912.5	
933	1925	
956	1937.5	
983	1950	
1014	1950	POINT G

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 81
MINE : GREENHILLS
DUMP DESIGNATION : EAST 2140
FAILURE DATE : 07 MAR 87

COMPUTER FILES
123 : 81COOR.WK1
GRAPHER
GRAPH : 81SECT
NAT. G. SURFACE : 81GS.DAT
DUMP SURFACE : 81SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2140
60	2125
118	2100
160	2075
240	2050
280	2037
310	2025
345	2012
375	2000
396	1992
415	1987.5
438	1982.5
466	1980
478	1977.5
496	1975
504	1974

TERMINUS

DUMP SURFACE COORDINATES (m)	
X	Y
0	2140
100	2140
225	2053

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 89
MINE : GREENHILLS
DUMP DESIGNATION : NORTH 2100
FAILURE DATE : 01 JULY 85

COMPUTER FILES
123 : 89COOR.WK1
GRAPHER
GRAPH : 89SECT
NAT. G. SURFACE : 89GS.DAT
DUMP SURFACE : 89SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	2100	
35	2075	
63	2050	
85	2025	
123	2000	
185	1975	
235	1950	
315	1925	
370	1900	
485	1875	
610	1850	
800	1825	
1060	1800	
1310	1775	
1350	1770	
1670	1740	END OF WASTE ROCK DEBRIS
1390	1765	START OF OVERBURDEN DEBRIS
1445	1765	
1480	1760	
1520	1755	
1600	1750	
1630	1745	
1685	1740	END OF OVERBURDEN DEBRIS

DUMP SURFACE COORDINATES (m)	
X	Y
0	2100
70	2100
105	2075
140	2050
180	2025
220	2000
260	1975
305	1950
350	1925
390	1900

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	112
MINE	QUINTETTE
DUMP DESIGNATION	1690 MT
FAILURE DATE	17 AUG 1984

COMPUTER FILES

123	112COOR.WK1
GRAPHER	
GRAPH	112SECT
NAT. G. SURFACE	112GS.DAT
DUMP SURFACE	112SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1690	
80	1650	
120	1625	
167	1600	
220	1575	
280	1550	
345	1525	
400	1500	
460	1475	
545	1450	
595	1440	
630	1425	
750	1400	
850	1375	
965	1350	
1015	1340	
1225	1315	
1240	1310	
1345	1290	TERMINUS

DUMP SURFACE COORDINATES (m)	
X	Y
0	1690
220	1690
552	1440

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 113
MINE : QUINTETTE
DUMP DESIGNATION : 1690 MT
FAILURE DATE : 04 OCT 1985

COMPUTER FILES
123 : 113COOR.WK1
GRAPHER
GRAPH : 113SECT
NAT. G. SURFACE : 113GS.DAT
DUMP SURFACE : 113SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1690	
28	1675	
75	1650	
120	1625	
160	1600	
215	1575	
270	1550	
320	1525	
375	1500	
440	1475	
490	1455	
635	1425	
760	1400	
820	1385	
1005	1330	
1370	1300	
1560	1275	
1700	1260	TERMINUS

DUMP SURFACE COORDINATES (m)	
X	Y
0	1690
220	1690
530	1450

DSS -- MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 149
MINE : FCL
DUMP DESIGNATION : BLAINE SPOIL
FAILURE DATE : 16 JULY 1986

COMPUTER FILES
123 : 149COOR.WK1
GRAPHER
GRAPH : 149SECT
NAT. G. SURFACE : 149GS.DAT
DUMP SURFACE : 149SS.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	1885	
40	1860	
70	1840	
130	1820	
205	1800	
265	1780	
350	1760	
420	1740	
470	1735	
510	1725	
570	1715	
595	1705	
620	1710	
645	1720	END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	1973
120	1965
250	1875
385	1775
420	1750

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 153
MINE : FCL
DUMP DESIGNATION : S.S. STG. 2, ACCESS ROAD
FAILURE DATE : 29 MAY 1990

COMPUTER FILES
123 : 153COOR.WK1
GRAPHER
GRAPH : 153SECT
NAT. G. SURFACE : 153GS.DAT
DUMP SURFACE : 153SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2140
30	2120
60	2100
99	2080
134	2060
172	2040
213	2020
256	2000
296	1980
347	1960
395	1940
436	1920
475	1900
570	1880
642	1860
710	1840

DUMP SURFACE COORDINATES (m)	
X	Y
22	2140
73	2140
248	2005

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 154
MINE : FCL
DUMP DESIGNATION : S.S. STG. 2 - ACCESS ROAD
FAILURE DATE : 07 JULY 1990

COMPUTER FILES
123 : 154COOR.WK1
GRAPHER
GRAPH : 154SECT
NAT. G. SURFACE : 154GS.DAT
DUMP SURFACE : 154SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2150
23	2120
56	2100
94	2080
133	2060
171	2040
210	2020
245	2000
290	1980
340	1960
390	1940
445	1920
538	1900
600	1880
662	1860
742	1840
813	1820
910	1800

DUMP SURFACE COORDINATES (m)	
X	Y
6	2150
44	2150
230	2010

DSS - MINE WASTE RUN OUT STUDY

P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 155
MINE : FCL
DUMP DESIGNATION : SOUTH SPOIL
FAILURE DATE : 26-Oct-89

COMPUTER FILES
123 : 155COOR.WK1
GRAPHER
GRAPH : 155SECT
NAT. G. SURFACE : 155GS.DAT
DUMP SURFACE : 155SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	2195
22	2180
54	2160
83	2140
105	2125
125	2115
138	2105
165	2090
180	2080
250	2040
284	2020
330	2000
370	1980
414	1960
462	1940
500	1920
532	1900
580	1880
610	1860
660	1840
705	1820
755	1800
795	1785
845	1770
885	1760
945	1750
968	1740
1010	1730
1030	1720
1100	1720
1130	1695
1154	1680
1200	1675
1225	1660
1290	1660
1315	1665
1386	1665
1410	1675
1440	1685
1480	1693

END OF FAILURE

DUMP SURFACE COORDINATES (m)	
X	Y
0	2195
195	2195
355	2060
547	1915
614	1860
650	1850
775	1800
900	1765
920	1760
950	1750

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 156
MINE : WESTAR GREENHILLS
DUMP DESIGNATION : 2031 NORTH DUMP
FAILURE DATE : 22 NOV. 1989

COMPUTER FILES
123 : 156COOR.WK1
GRAPHER
GRAPH : 156SECT
NAT. G. SURFACE : 156GS.DAT
DUMP SURFACE : 156SS.DAT
TOP OF FAILURE : 156TD.DAT

NAT. GR. SURFACE COORDINATES (m)		
X	Y	
0	2031	
7	2025	
40	2000	
70	1975	
83	1950	
120	1925	
157	1900	
200	1875	
250	1850	
290	1825	
340	1800	
385	1791	BEND AT SECTION AT CATARAT CREEK
395	1790	
465	1785	
500	1780	
545	1775	
665	1760	
835	1745	
960	1734	BEND IN SECTION
1090	1725	
1250	1715	
1350	1705	BEND IN SECTION
1480	1695	
1610	1685	
1740	1675	BEND IN SECTION
1790	1670	
1890	1665	
1995	1655	BEND IN SECTION
2135	1645	
2260	1635	
2340	1630	TERMINUS

DUMP SURFACE COORDINATES (m)		
X	Y	
0	2031	
60	2031	SCARP
90	2031	CREST
360	1825	
385	1806	BEND IN SECTION
525	1800	
580	1775	

TOP SURFACE OF FAILURE DEBRIS COORDINATES (M)	
X	Y
250	1850
330	1865
540	1845
640	1815
710	1795
950	1755
1015	1745
1135	1740
1350	1715
1480	1702
1610	1690
1740	1680
1790	1675
1890	1667
1995	1655

DSS - MINE WASTE RUN OUT STUDY
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 157
MINE : QINTETTE
DUMP DESIGNATION : 1660 DUMP
FAILURE DATE : Nov. 07, 1987

COMPUTER FILES
123 : 157COOR.WK1
GRAPHER
GRAPH : 155SECT
NAT. G. SURFACE : 157GS.DAT
DUMP SURFACE : 157SS.DAT

NAT. GR. SURFACE COORDINATES (m)

X	Y	
0	1505	
40	1490	
100	1470	
200	1445	
300	1425	
400	1400	
500	1375	
600	1360	
700	1350	BEND IN SECTION
830	1310	
910	1320	
935	1310	
965	1305	
1065	1300	
1150	1285	
1210	1270	
1230	1265	
1310	1255	BEND IN SECTION
1420	1250	
1470	1240	
1525	1230	
1650	1230	
1725	1220	
1760	1210	
1860	1200	
2170	1180	
2280	1180	
2400	1175	
2435	1170	
2465	1155	
2530	1150	TERMINUS

DUMP SURFACE COORDINATES (m)

X	Y
0	1660
85	1660
200	1570
350	1470
425	1420
550	1380

DEBRIS ALONG BOTTOM OF RUNOUT PATH FAILURE #49 COORDINATES (M)

X	Y	
700	1370	
830	1350	
900	1340	
935	1335	
995	1325	
1010	1320	
1130	1300	BEND IN SECTION
1215	1295	
1265	1280	
1395	1270	
1430	1265	
1460	1255	
1600	1245	
1680	1230	
1800	1225	
1900	1220	

TOP SURFACE OF DEBRIS (FAILURE # 157) COORDINATES (M)

X	Y
595	1400
750	1375
875	1350
1035	1325
1185	1300
1350	1275
1580	1250
1940	1225
2140	1200
2480	1175

DSS - MINE WASTE RUN OUT STUDY P91-1209
RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER : 158
MINE : QUINTETTE
DUMP DESIGNATION : WOLVERINE WEST
FAILURE DATE : 13 MAY 1988

COMPUTER FILES
123 : 158COOR.WK1
GRAPHER
GRAPH : 158SECT
NAT. G. SURFACE : 158GS.DAT
DUMP SURFACE : 158SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
0	1680
27	1670
60	1650
75	1630
80	1625
101	1605
140	1575
167	1555
210	1525
250	1500
290	1475
315	1450
395	1425
490	1400
600	1375
720	1350
820	1325
955	1300
1130	1268

DUMP SURFACE COORDINATES (m)	
X	Y
0	1680
23	1680
350	1440

DSS - MINE WASTE RUN OUT STUDY P91-1209

RUN OUT SECTION DATA FILE

DATA BASE FILE NUMBER	:	162
MINE	:	FCL
DUMP DESIGNATION	:	BROWNIE SPOIL - F GULLY
FAILURE DATE	:	JUNE _, 1983

COMPUTER FILES

123	:	162COOR.WK1
GRAPHER		
GRAPH	:	162SECT
NAT. G. SURFACE	:	162GS.DAT
DUMP SURFACE	:	162SS.DAT

NAT. GR. SURFACE COORDINATES (m)	
X	Y
-60	2350
-47	2340
-20	2320
8	2300
43	2280
75	2260
105	2240
138	2220
167	2200
238	2150
337	2100
408	2060
538	2000
683	1960
736	1940
770	1928
840	1908
873	1900
960	1880

DUMP SURFACE COORDINATES (m)		
X	Y	
-60	2350	
-50	2350	CREST
43	2280	TOE

Volume

2

Mined Rock and Overburden Piles

Failure Runout Characteristics, Volume II

Interim
Report

March, 1992

British Columbia
Mine Waste
Rock Pile
Research
Committee

Golder Associates Ltd.
CONSULTING ENGINEERS

REPORT
TO
DEPARTMENT OF SUPPLY AND SERVICES
CONTRACT NO. 23440-0-9198/01-X8G

RE
RUNOUT CHARACTERISTICS OF DEBRIS FROM DUMP FAILURES IN MOUNTAINOUS TERRAIN

STAGE 1
DATA COLLECTION

VOLUME II
DRAWINGS AND PHOTOGRAPHS

September, 1991

912-1413

Canadian Cataloguing in Publication Data
Golder Associates.
Interim report to Department of Supply and Services Contract No. 23440-0-9198/01-X8G re: runout characteristics of debris from dump failures in mountainous terrain

Added title on cover: Mined rock and overburden piles.
Issued by the Ministry of Energy, Mines and Petroleum Resources.
Contents: v. 1. Text and tables -- v. 2. Drawings and photographs
ISBN 0-7718-9175-X (set)

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TD899.M5G64 1992 622'.334 C92-092141-8

Recycled Paper

FOREWORD

Mine waste rock and overburden dumps are massive structures. Mountain top coal mines in British Columbia are constructing the largest man-made structures on the face of the earth. These immense waste dumps are often up to 400 meters high, contain in excess of one billion cubic meters of material, and often form mid-valley fills or rock drains. Instability of the structures has caused increased concern by mine operators and government regulators because of risk to the safety of personnel, equipment and infrastructure, and their impact on the environment.

In mid-1990 representatives of industry, CANMET, and the Ministries of Environment, and Energy, Mines and Petroleum Resources formed the Mine Waste Rock Pile Research Committee to foster research work and ensure a common understanding of these waste dumps.

The Interim Guidelines, published in May 1991, were the first two documents in a series undertaken by the committee. Three Interim Reports (Methods of Monitoring, Failure Runout Characteristics, Volumes I and II, and Review and Evaluation of Failures) continue the series of studies directed at improving our understanding of behaviour and developing a consistent database for waste dumps. Prominent geotechnical consultants and industry representatives have contributed their expertise to the studies.

The interim studies are being widely distributed by the Ministry of Energy, Mines And Petroleum Resources in the hope that all concerned with mine dumps will find them useful in establishing dumps that are stable, safe, and economically feasible. I anticipate that the studies will be distilled in the next year to develop a standard for investigation, design, operation, and monitoring of mine dumps.

In April 1992 the committee is sponsoring a series of workshops to introduce all of the studies to key industry personnel.

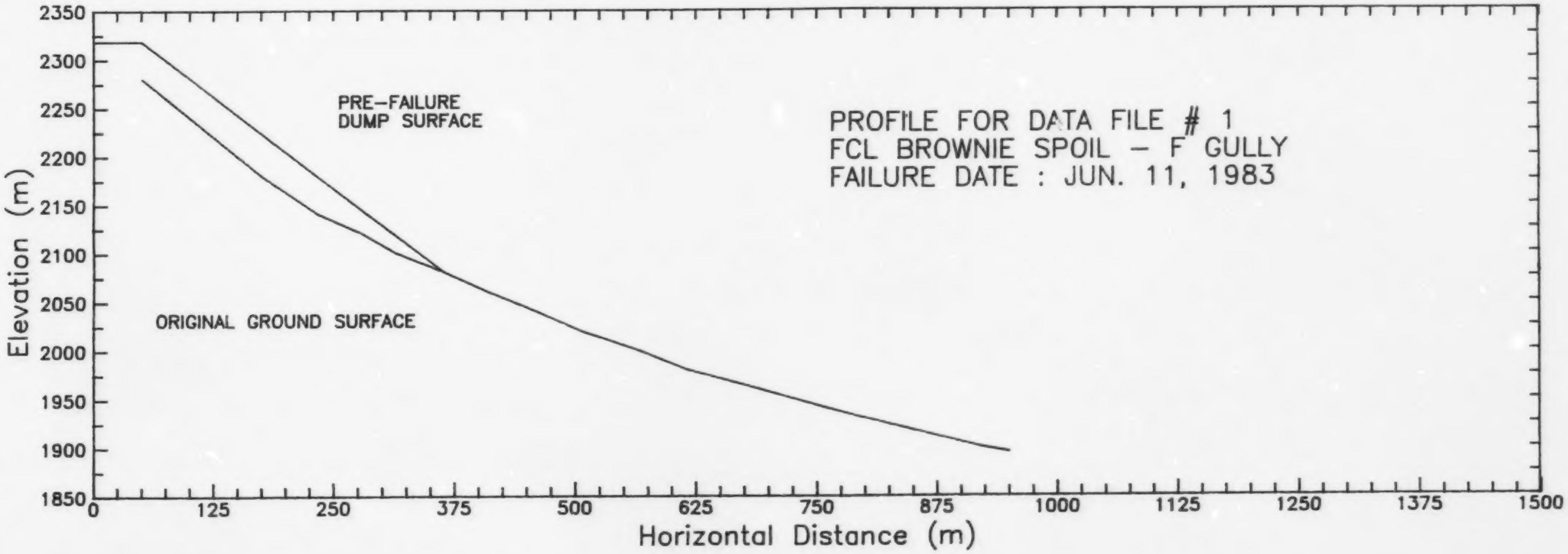
Tim Eaton, P.Eng.
Geotechnical Manager
Resource Management Branch

March 6, 1992

RESEARCH PROJECTS COMPLETED BY THE COMMITTEE

Investigation and Design Manual	(1991)
Operating and Monitoring Manual	(1991)
Methods of Monitoring	(1992)
Failure Runout Characteristics - Volumes I and II	(1992)
Review and Evaluation of Failures	(1992)

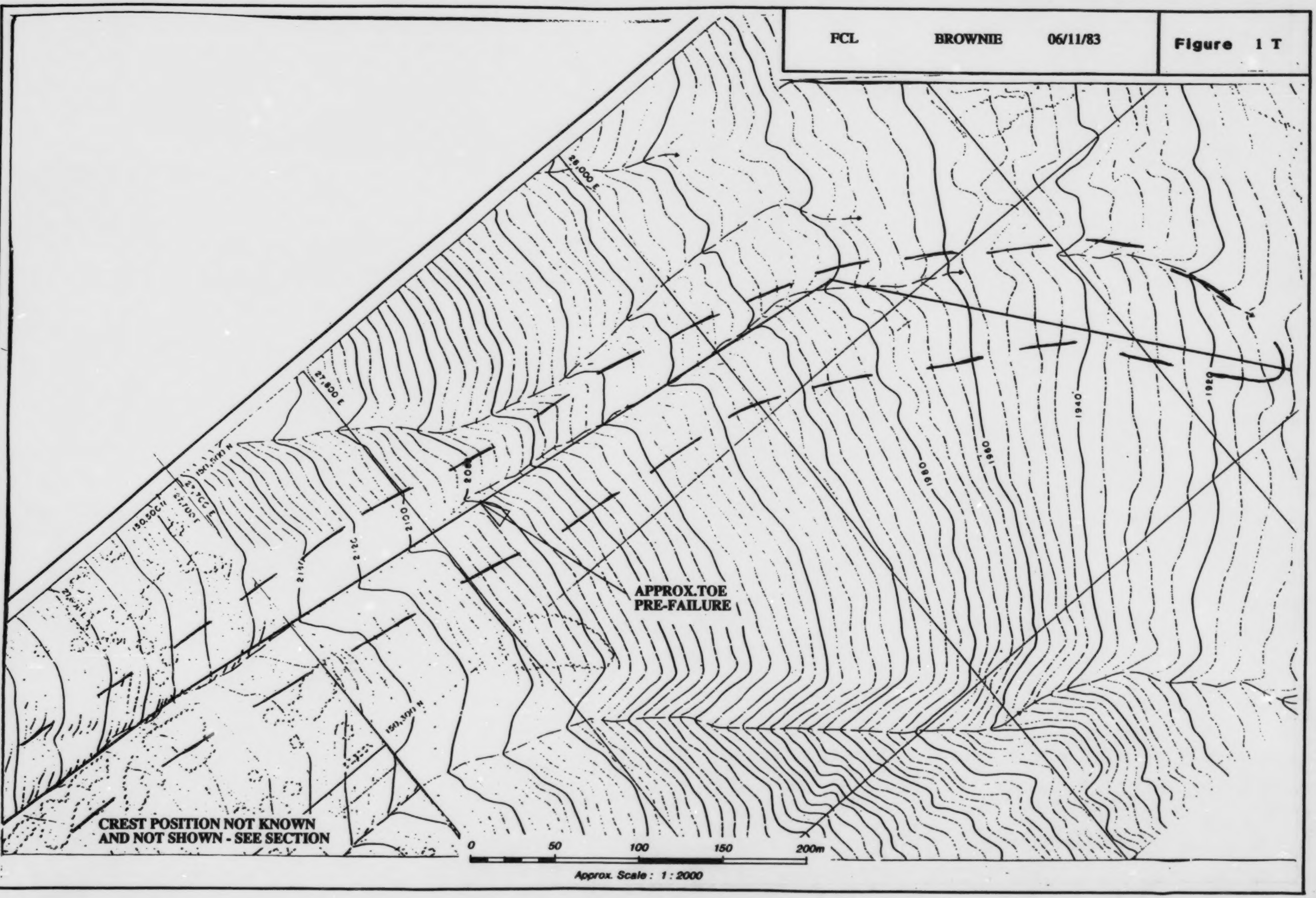
FCL **BROWNIE** **06/11/83** **Figure 1 S**



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

FCL **BROWNIE** **06/11/83**

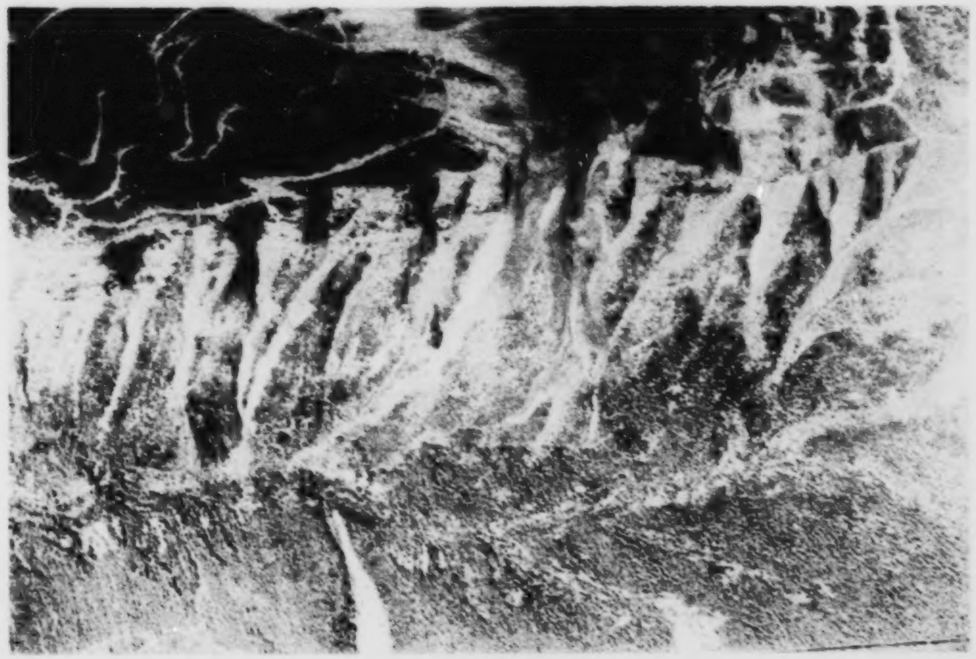
Figure 1 T

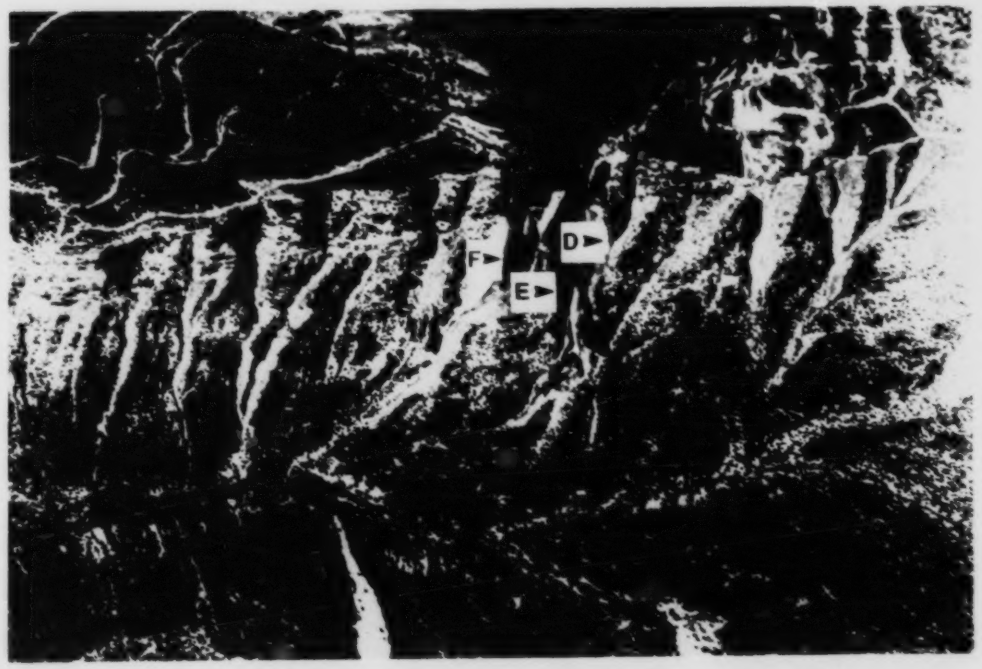

28,000 E
27,800 E
150,500 N
150,300 N
2080
2100
2120
2140
1980
1960
1940
1920
APPROX.TOE
PRE-FAILURE
CREST POSITION NOT KNOWN
AND NOT SHOWN - SEE SECTION
0
50
100
150
200m
Approx. Scale : 1 : 2000

PRC. FCT NO. 9/2/4/3 DRAWN AK REVIEWED .... DATE AUG 91

FCL BROWNIE 06/11/83

Figure 1 P





GULLEY F GULLEY E GULLEY D

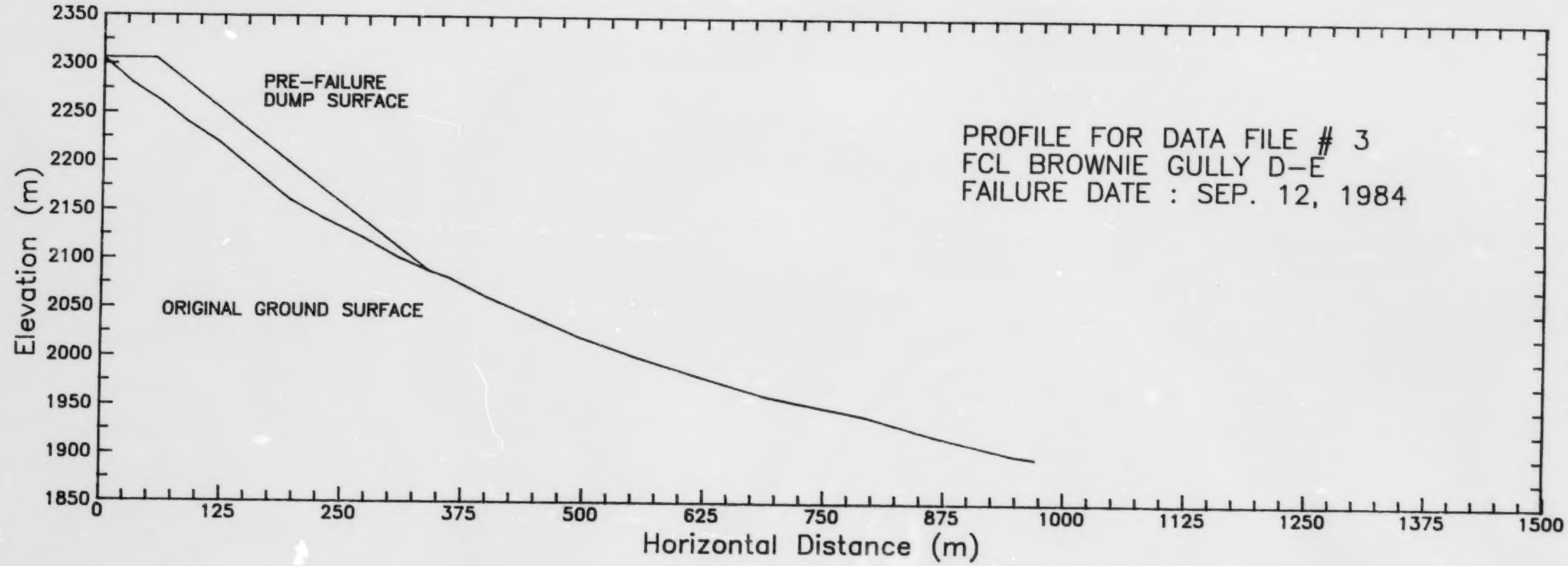
TEST PIT THROUGH
DISTAL PORTION OF
GULLEY E DEBRIS

DISTAL PORTION
OF DEBRIS IN
GULLEY E

PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

FCL **BROWNIE** **09/21/84**

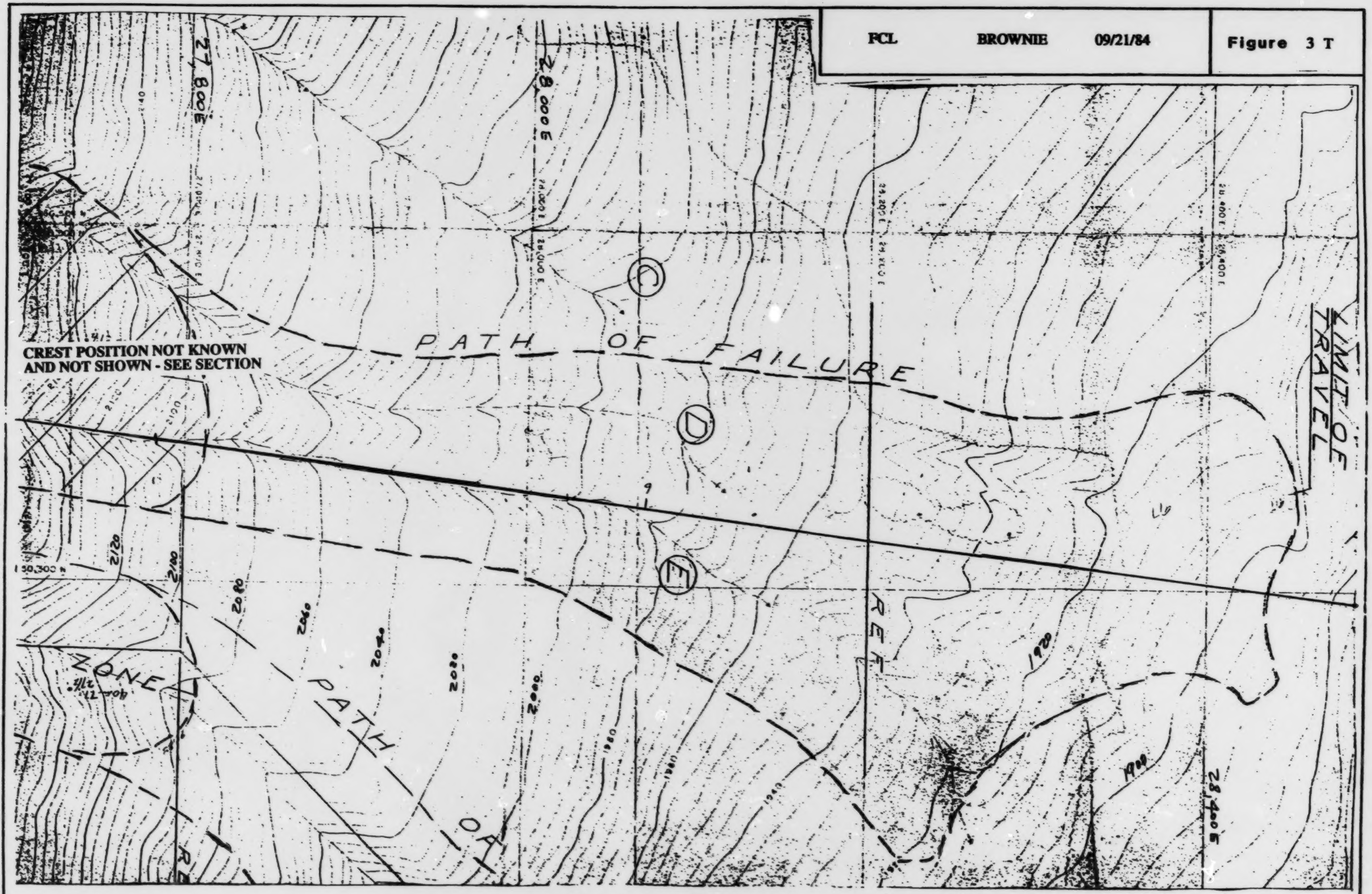
Figure 3 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

FCL **BROWNIE** **09/21/84**

Figure 3 T


27,800E
28,000E
28,400E
PATH OF FAILURE
LIMIT OF TRAVEL
ZONE
PATH OF
REF
C
D
E
2120
2100
2080
2060
2040
2020
2000
1980
1960
1940
1920
1900
50,300 N

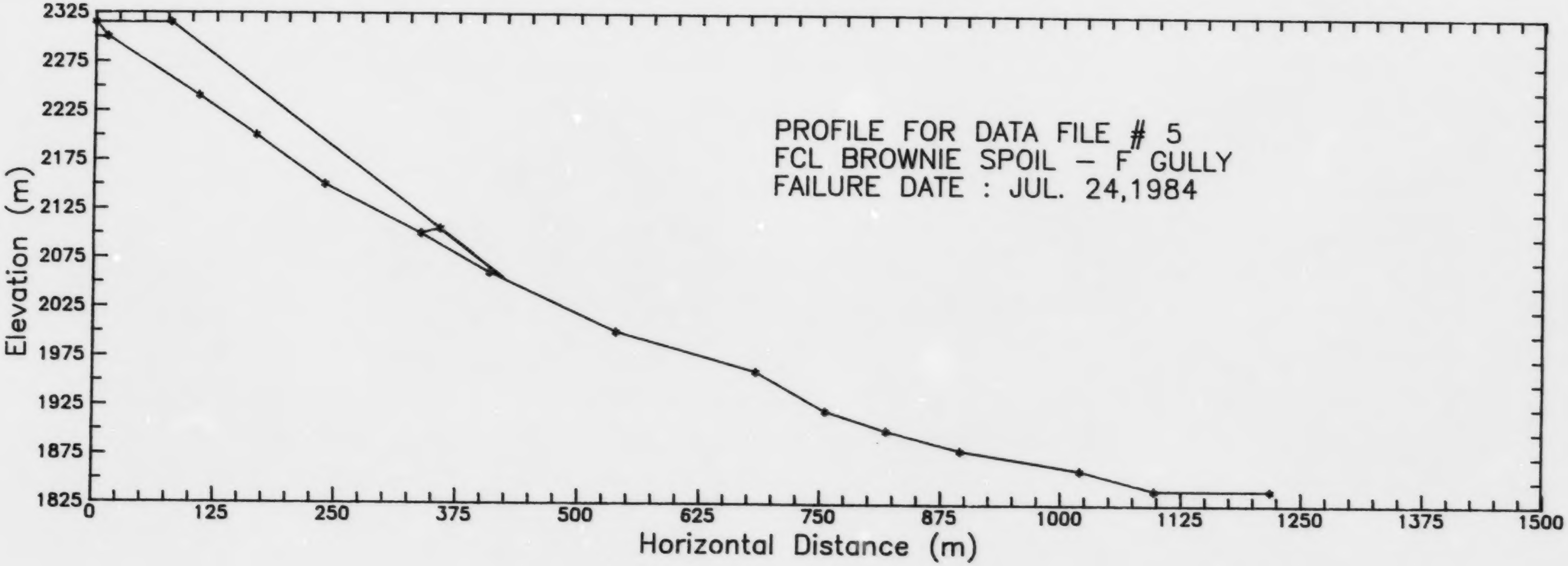
CREST POSITION NOT KNOWN
AND NOT SHOWN - SEE SECTION

1 : 2000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

FCL **BROWNIE** **07/24/84**

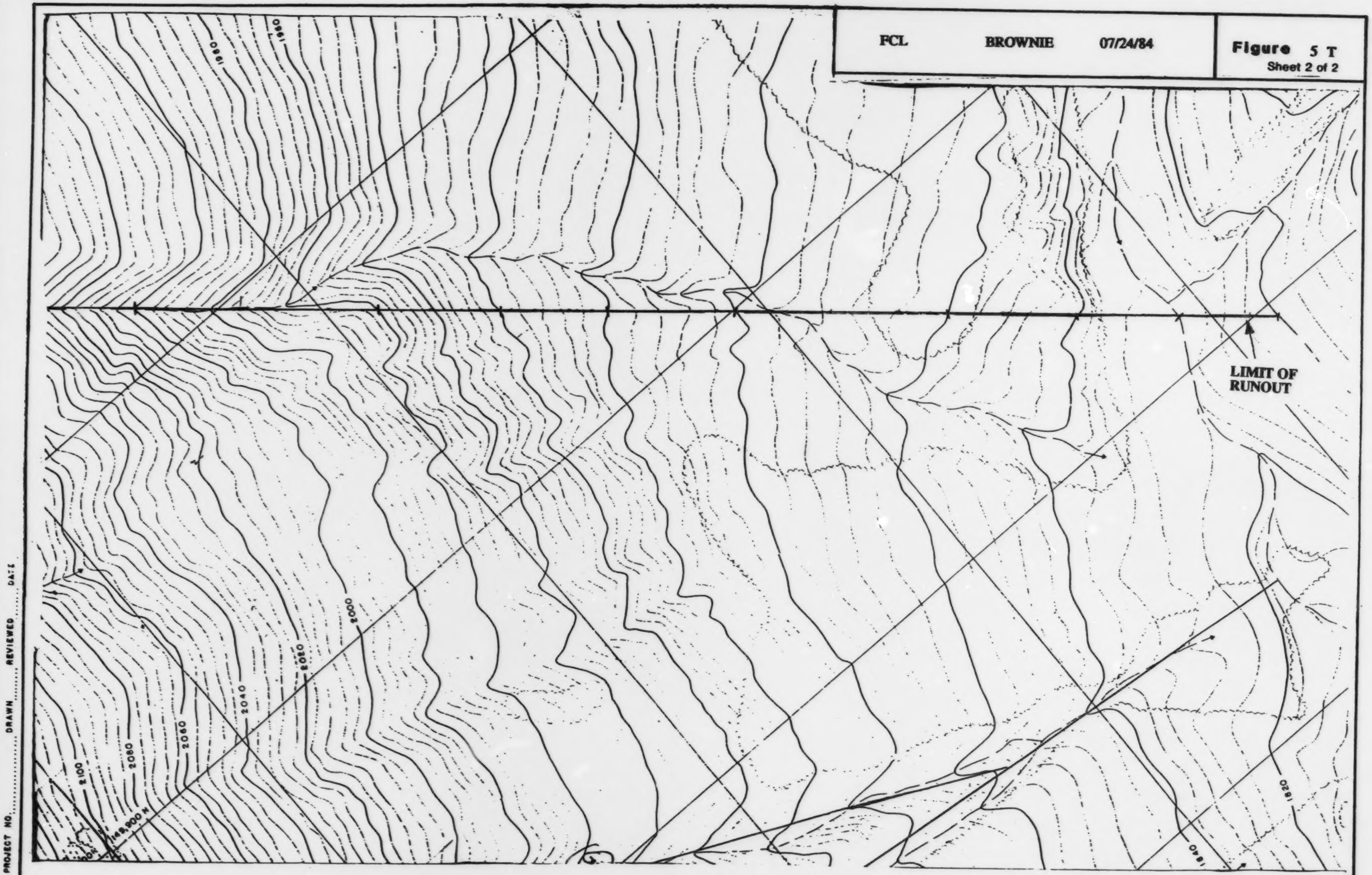
Figure 5 S



PROJECT NO. 912-1413 DRAWN ...... REVIEWED ...... DATE Sept. '91

FCL BROWNIE 07/24/84

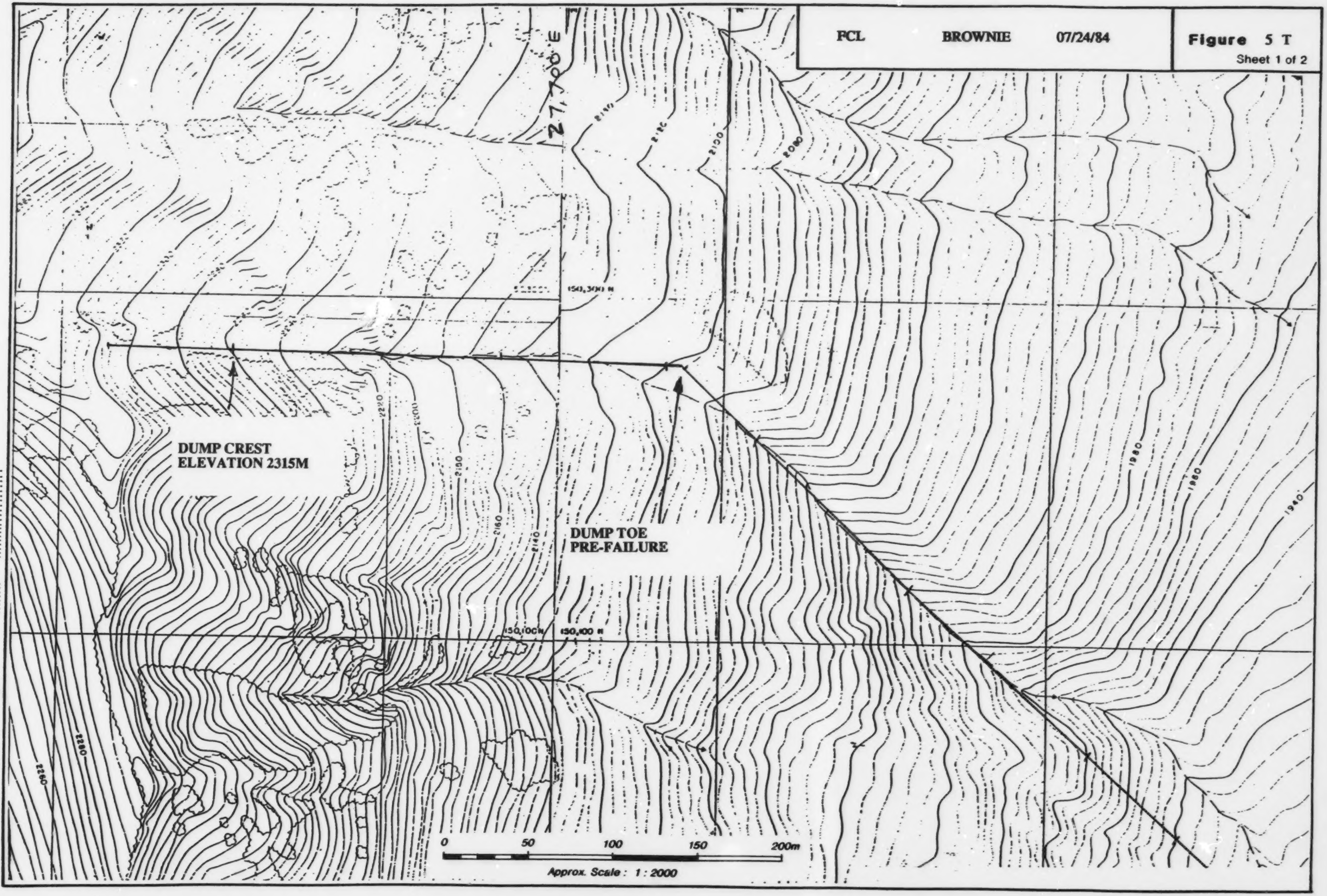
Figure 5 T
Sheet 2 of 2


1980
1960
LIMIT OF RUNOUT
2000
2020
2040
2060
2080
2100
149,900 N
1820
1840

PROJECT NO.......... DRAWN.......... REVIEWED.......... DATE..........

FCL BROWNIE 07/24/84

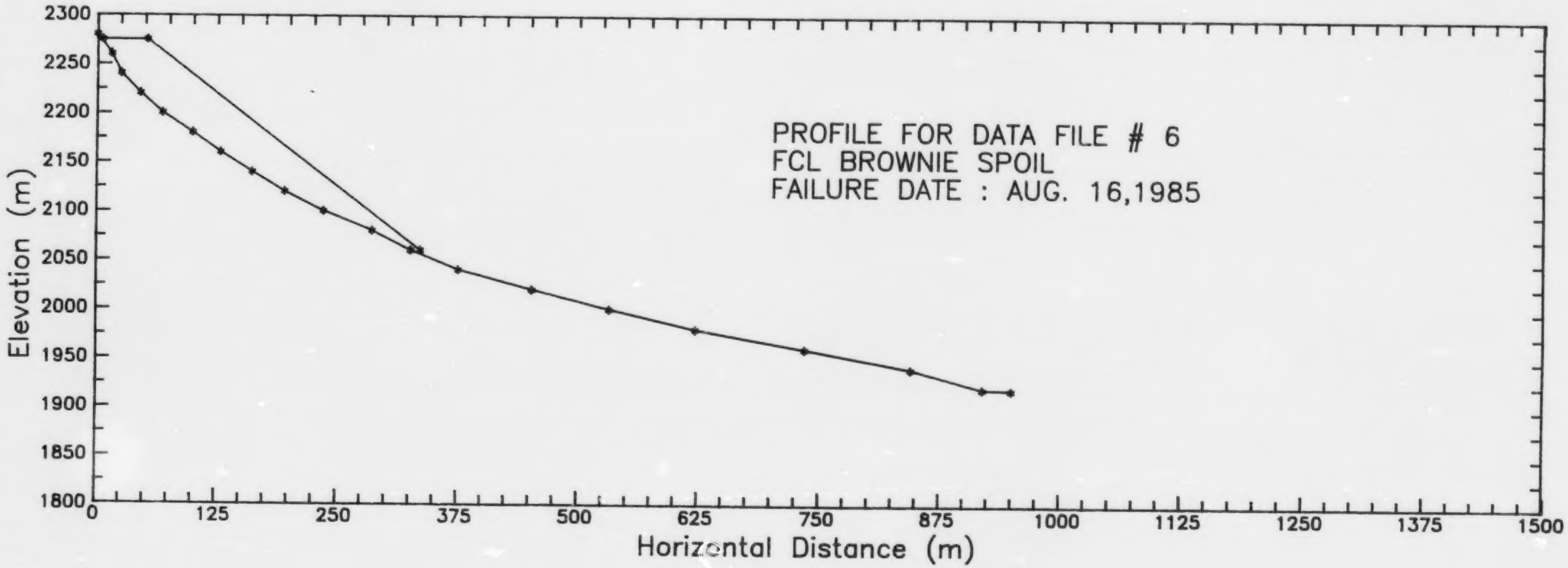
Figure 5 T
Sheet 1 of 2


27,700 E
2140
2120
2100
2080
150,300 N
DUMP CREST
ELEVATION 2315M
DUMP TOE
PRE-FAILURE
2220
2200
2180
2160
2140
1980
1960
1940
150,100 N
0
50
100
150
200m
Approx. Scale : 1 : 2000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

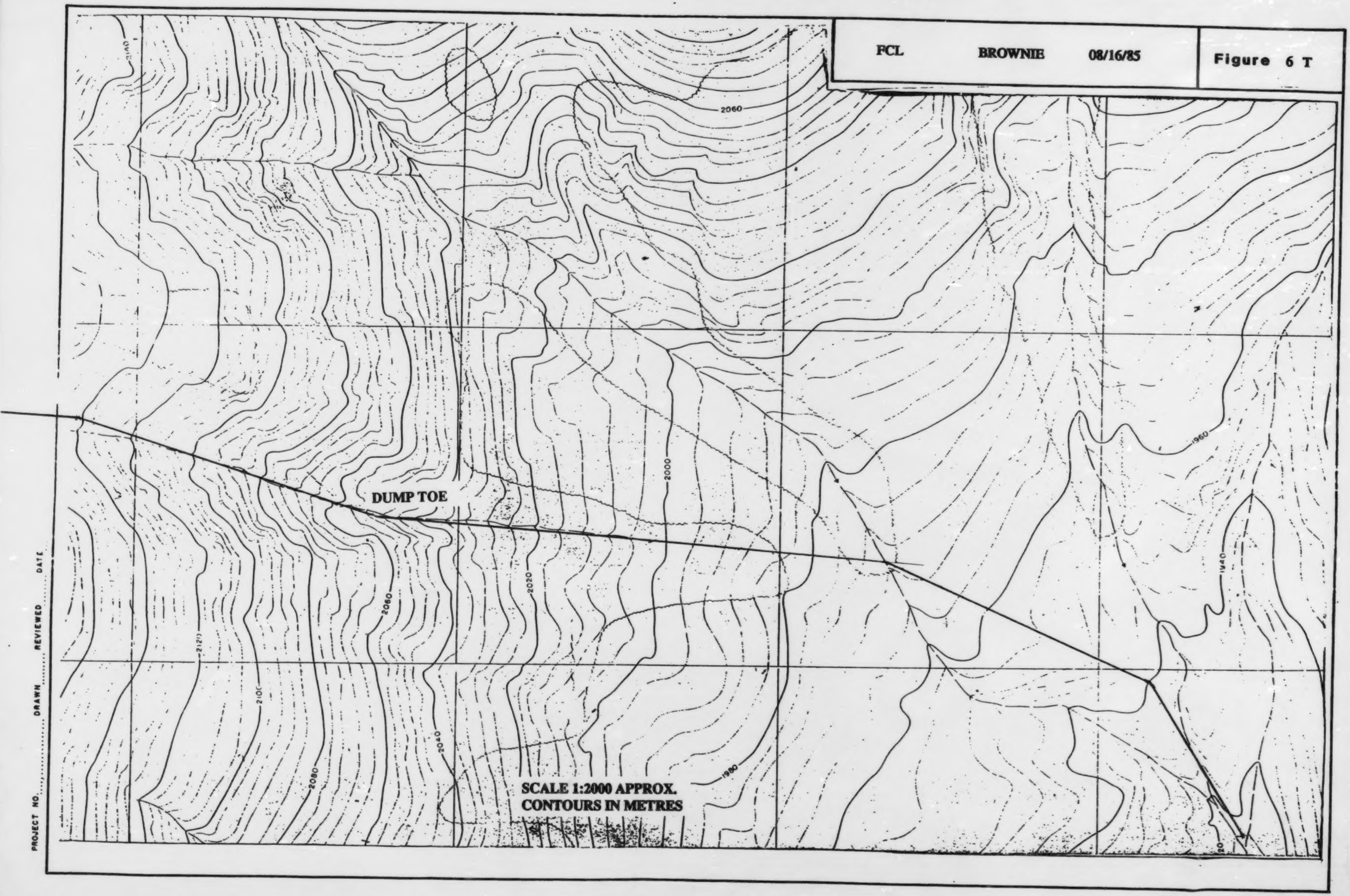
FCL BROWNIE 08/16/85

Figure 6 S



FCL BROWNIE 08/16/85

Figure 6 T

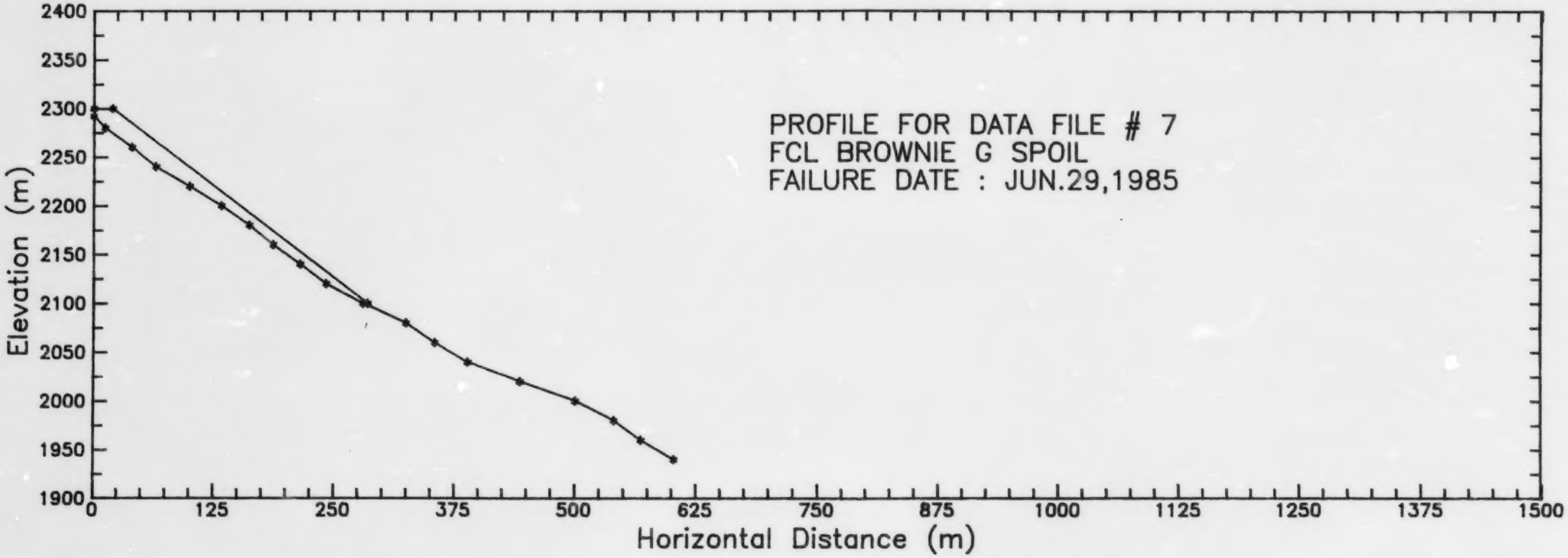

2140
2060
DUMP TOE
2000
1960
1940
2120
2100
2080
2060
2040
2020
1980
20

SCALE 1:2000 APPROX.
CONTOURS IN METRES

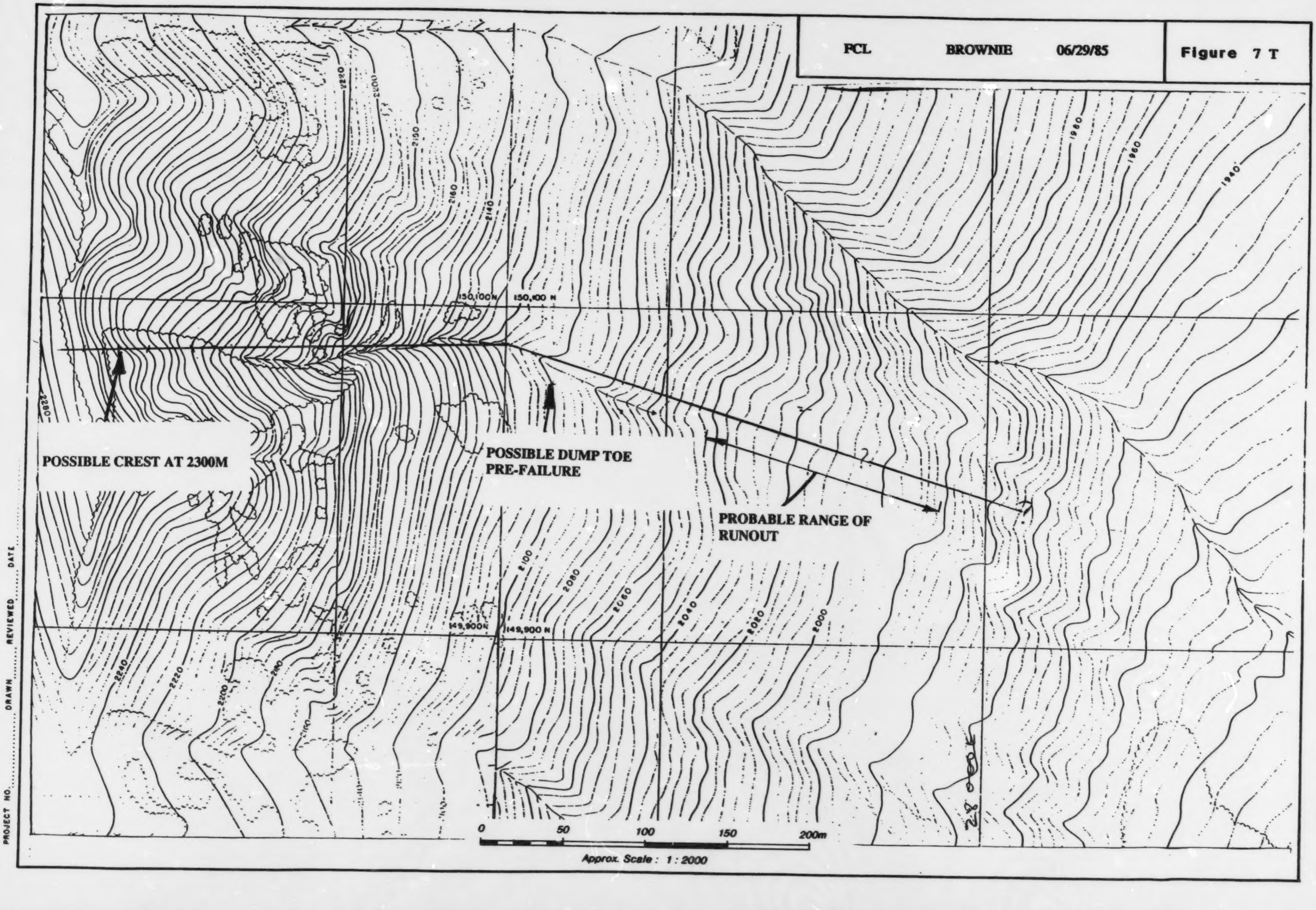
PROJECT NO. .... DRAWN .... REVIEWED .... DATE

FCL **BROWNIE** **06/29/85**

Figure 7 S



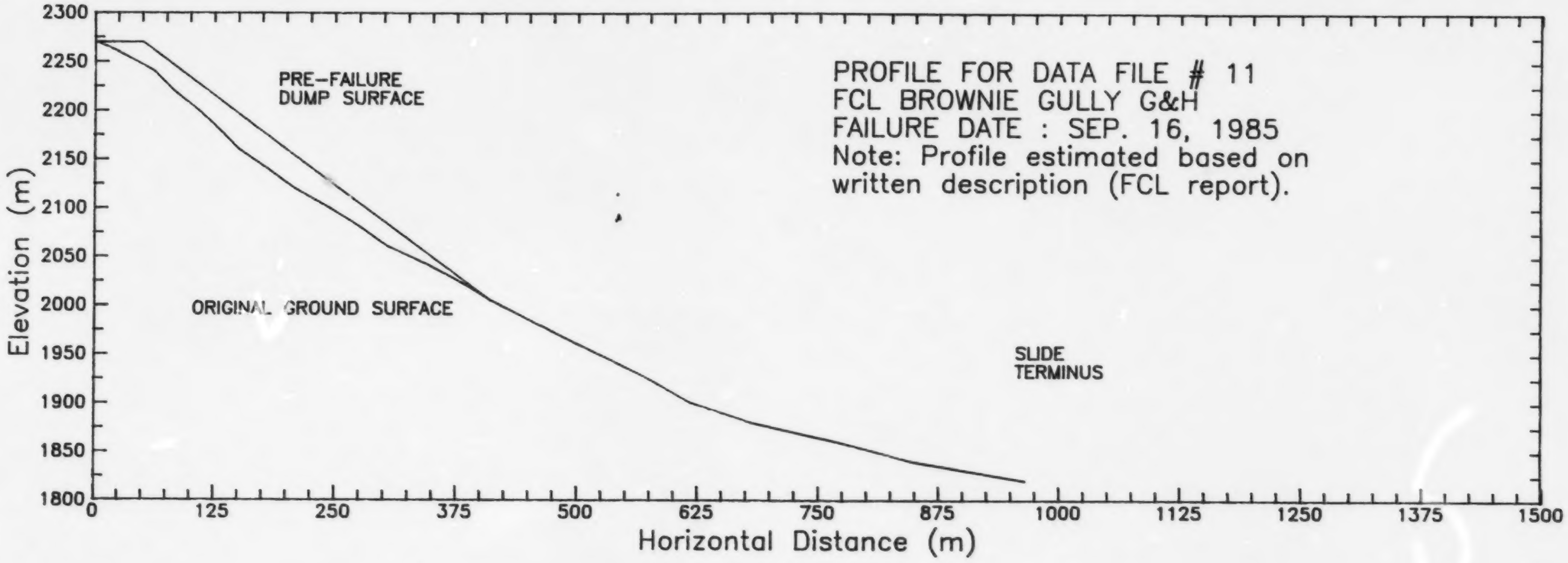
PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91


PCL
BROWNIE
06/29/85
Figure 7 T
POSSIBLE CREST AT 2300M
POSSIBLE DUMP TOE PRE-FAILURE
PROBABLE RANGE OF RUNOUT
?
150,100N
150,100 N
149,900N
149,900 N
2280
2240
2220
2200
2190
2180
2160
2140
2120
2100
2080
2060
2040
2020
2000
1980
1960
1940
0
50
100
150
200m
Approx. Scale : 1 : 2000

28 of 84

PROJECT NO.......... DRAWN.......... REVIEWED.......... DATE..........

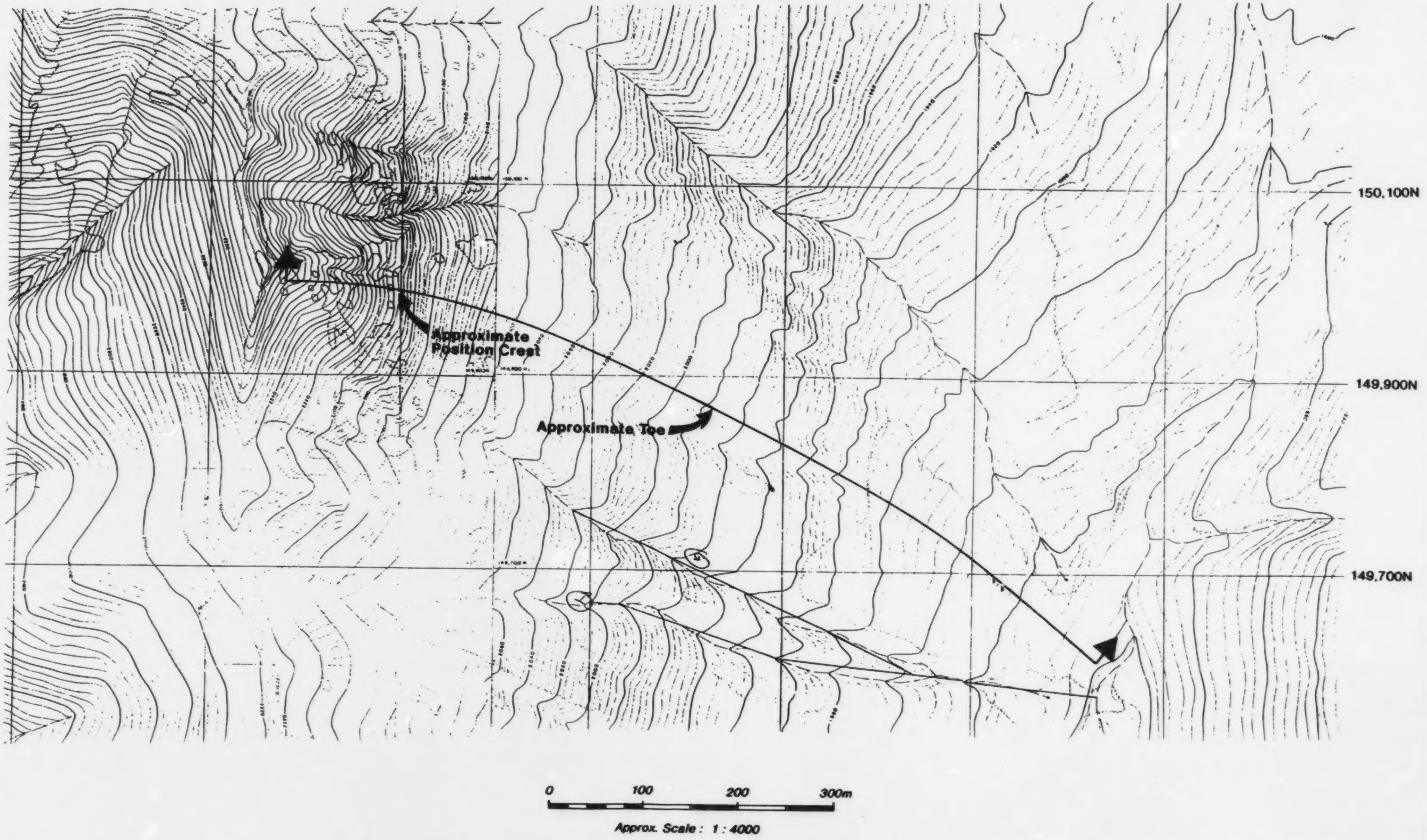
FCL	BROWNIE	09/16/85	**Figure 11 S**



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

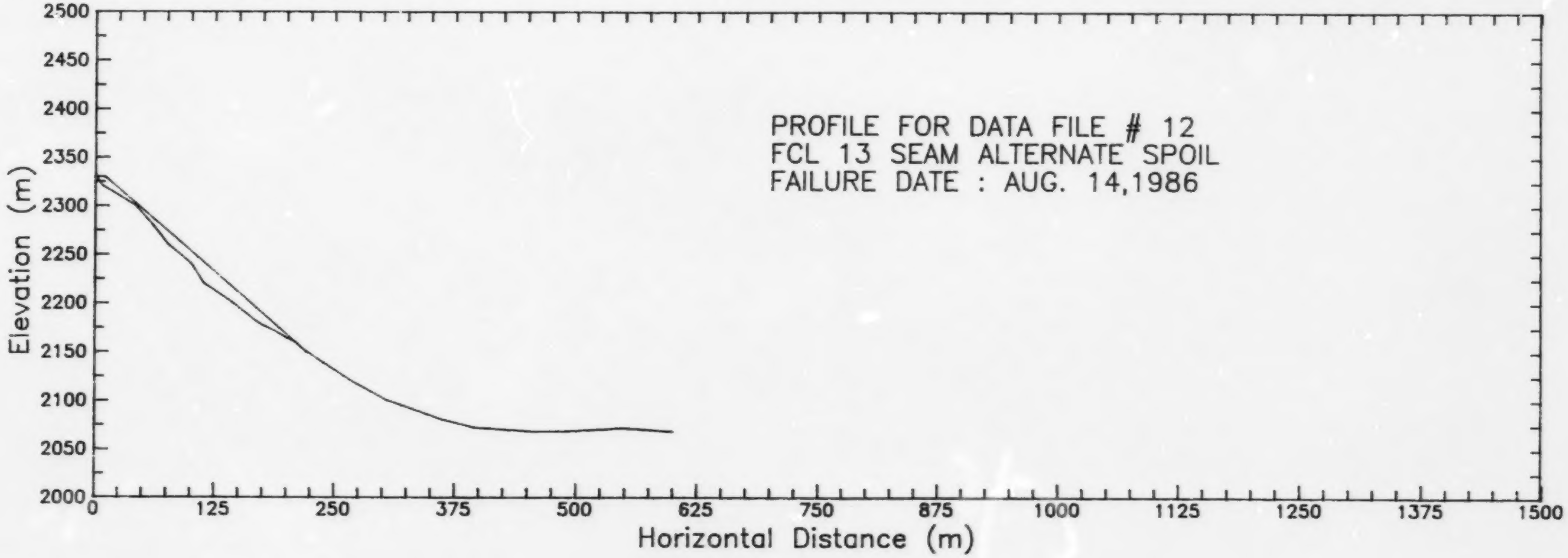
FCL **BROWNIE** **09/16/85**

Figure 11 T


150,100N
149,900N
149,700N
Approximate Position Crest
Approximate Toe
0
100
200
300m
Approx. Scale : 1 : 4000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

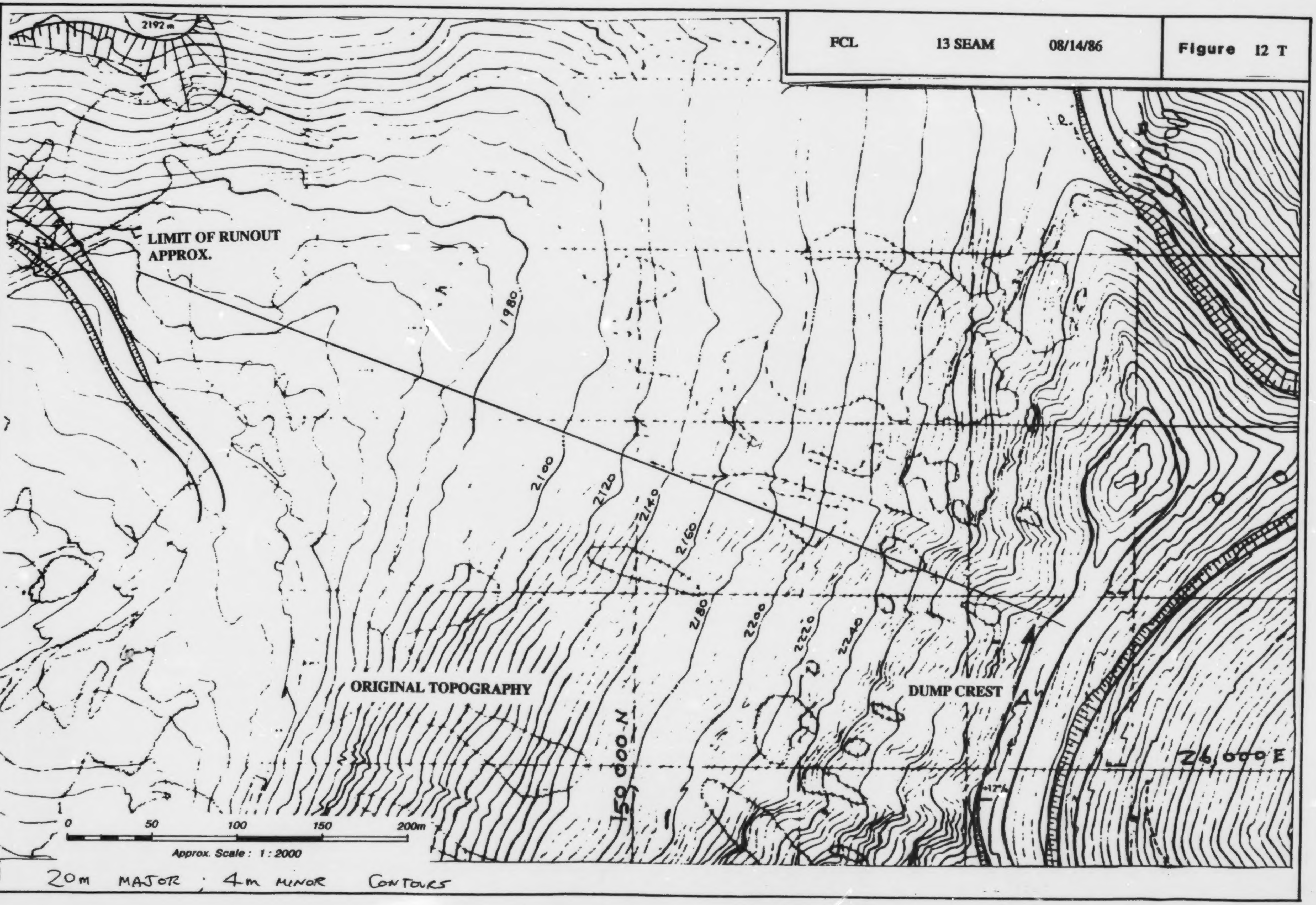
FCL	13 SEAM	08/14/86	**Figure** 12 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

FCL 13 SEAM 08/14/86

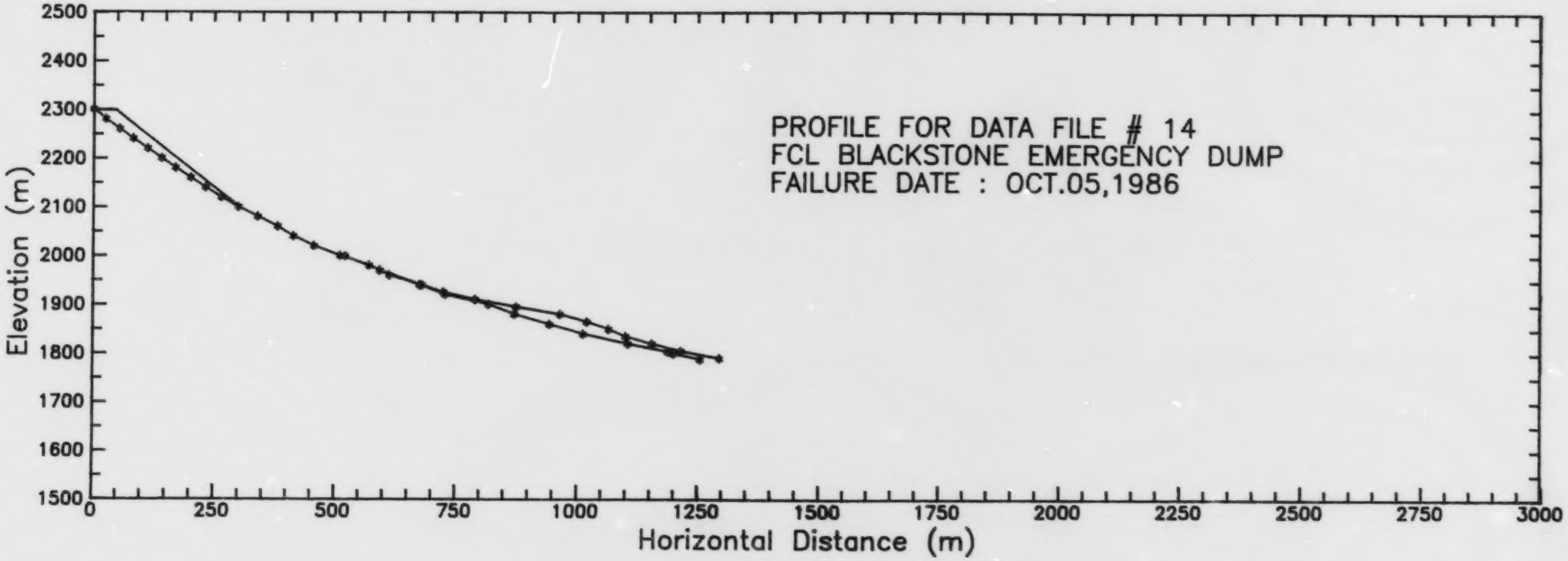
Figure 12 T


2192 m
LIMIT OF RUNOUT APPROX.
1980
2100
2120
2140
2160
2180
2200
2220
2240
ORIGINAL TOPOGRAPHY
DUMP CREST
150000 N
26000 E
12%
0
50
100
150
200m
Approx. Scale : 1 : 2000

20m MAJOR ; 4m MINOR CONTOURS

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

FCL **BLACKSTONE 10/05/86** **Figure 14 S**



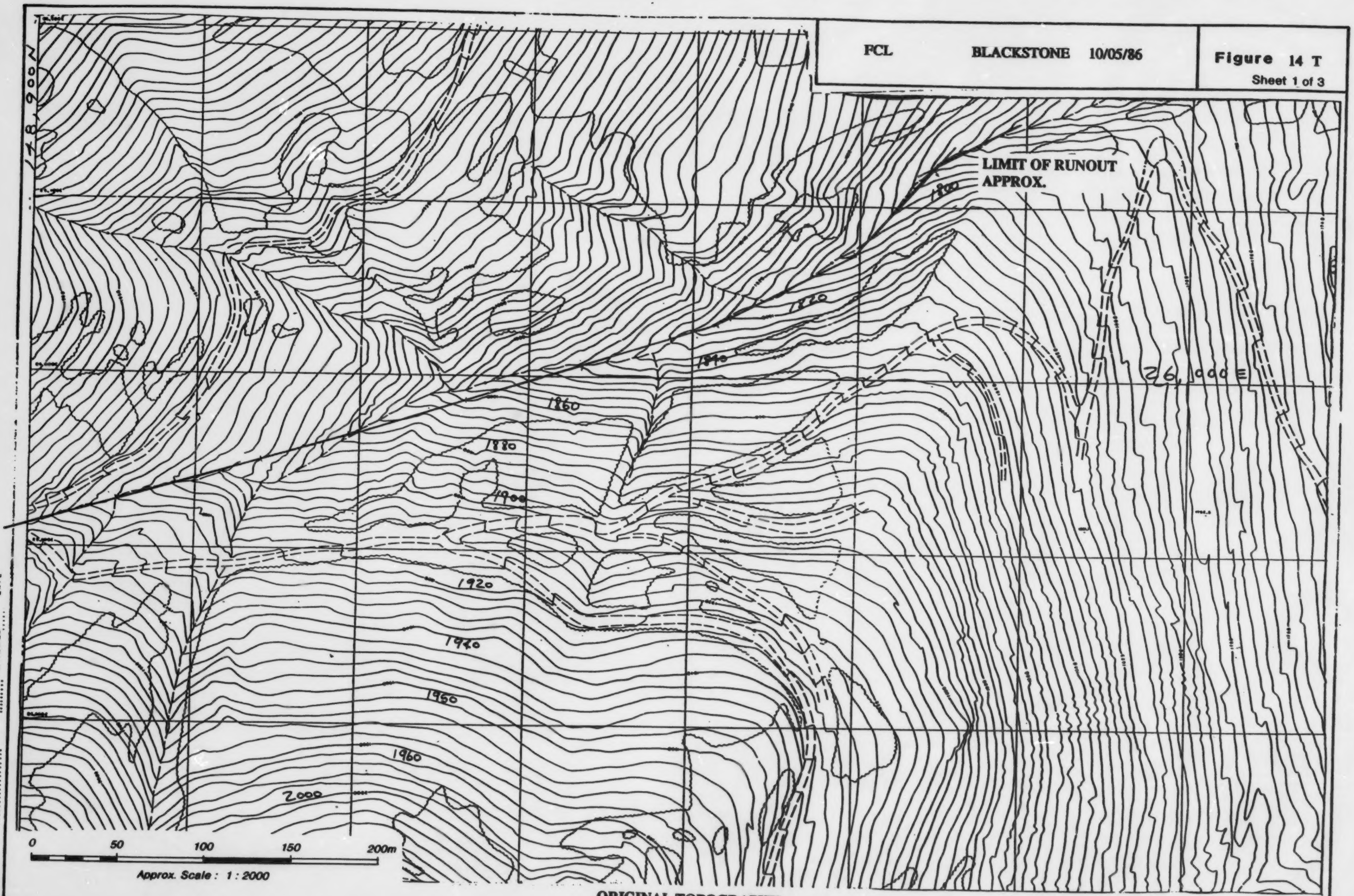
PROJECT NO. 912-14/13 DRAWN ...... REVIEWED ...... DATE Sept. '91

FCL BLACKSTONE 10/05/86

Figure 14 T

Sheet 1 of 3

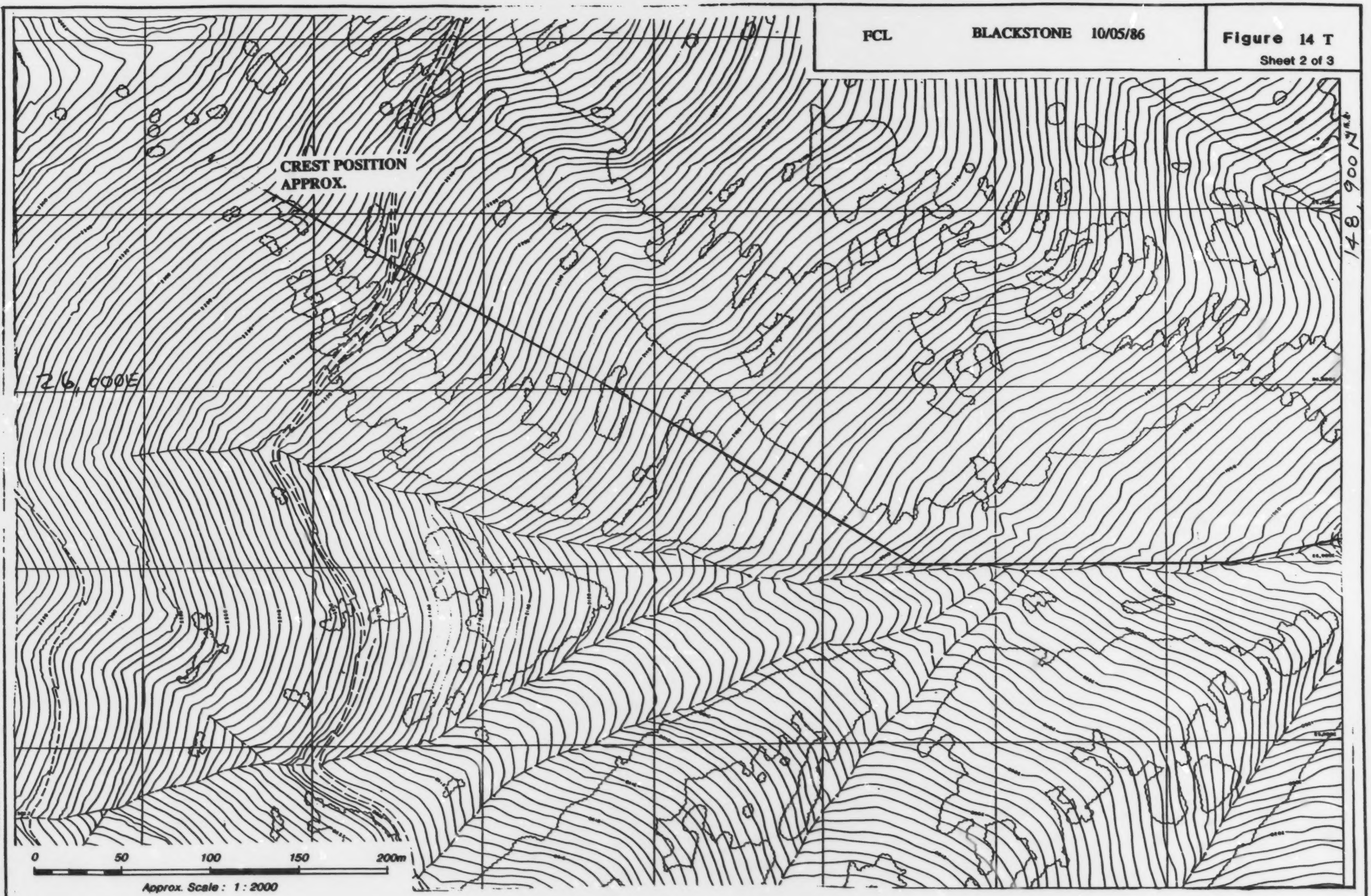
PROJECT NO. .... DRAWN .... REVIEWED .... DATE


148,900N
LIMIT OF RUNOUT APPROX.
1800
1820
1840
1860
1880
1900
1920
1940
1950
1960
2000
26,000E
0
50
100
150
200m
Approx. Scale : 1 : 2000

ORIGINAL TOPOGRAPHY

FCL BLACKSTONE 10/05/86

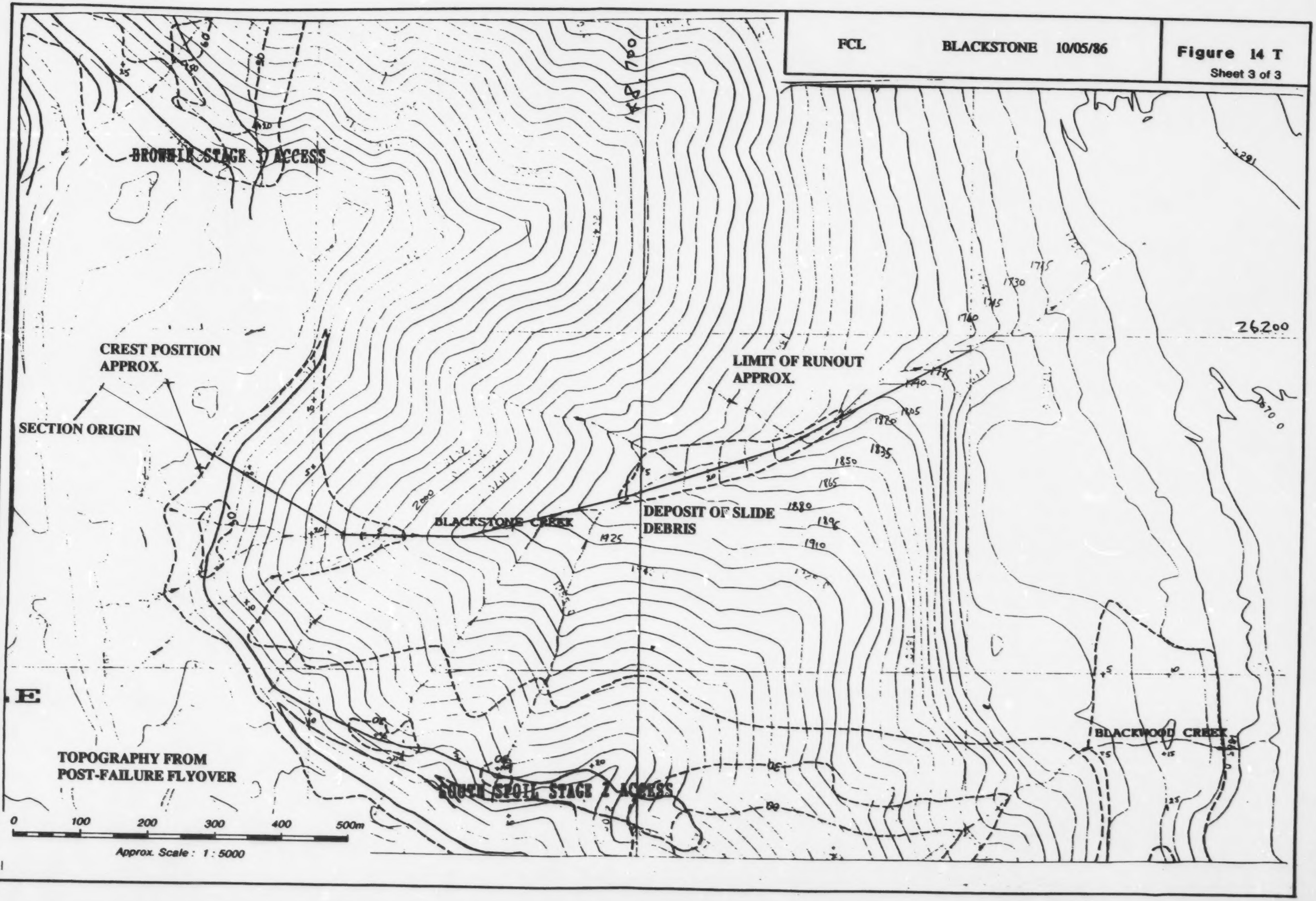
Figure 14 T
Sheet 2 of 3


CREST POSITION
APPROX.
26,000E
148,900N
0
50
100
150
200m
Approx. Scale : 1 : 2000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE

FCL BLACKSTONE 10/05/86

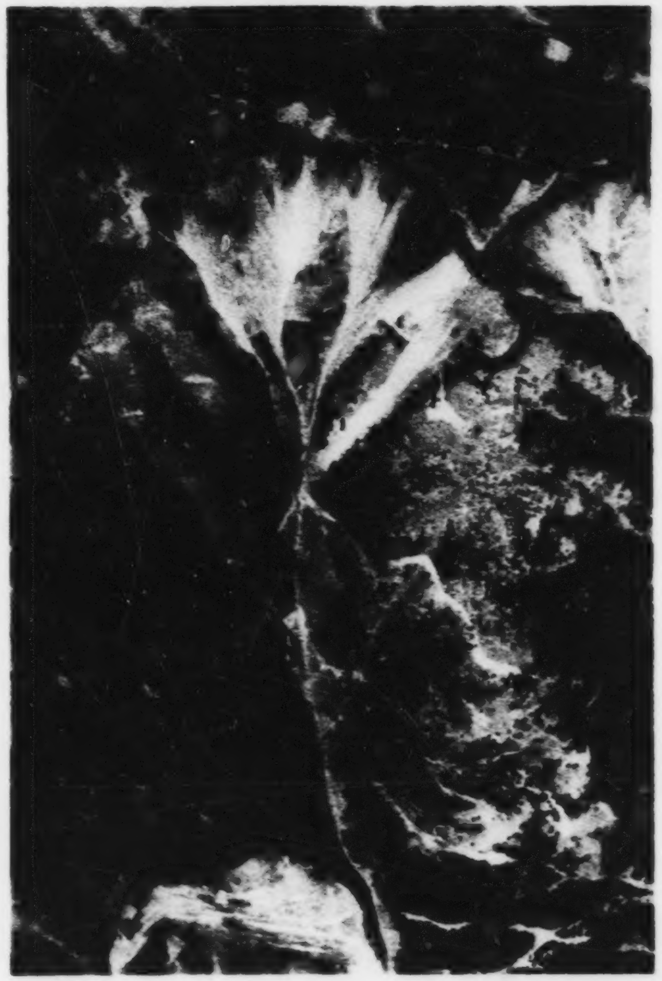
Figure 14 T
Sheet 3 of 3


BROWNIE STAGE 3 ACCESS
CREST POSITION APPROX.
SECTION ORIGIN
BLACKSTONE CREEK
2000
1925
DEPOSIT OF SLIDE DEBRIS
LIMIT OF RUNOUT APPROX.
1715
1730
1745
1760
1775
1790
1805
1820
1835
1850
1865
1880
1895
1910
26200
BLACKWOOD CREEK
SOUTH SPOIL STAGE 2 ACCESS
E
TOPOGRAPHY FROM POST-FAILURE FLYOVER
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

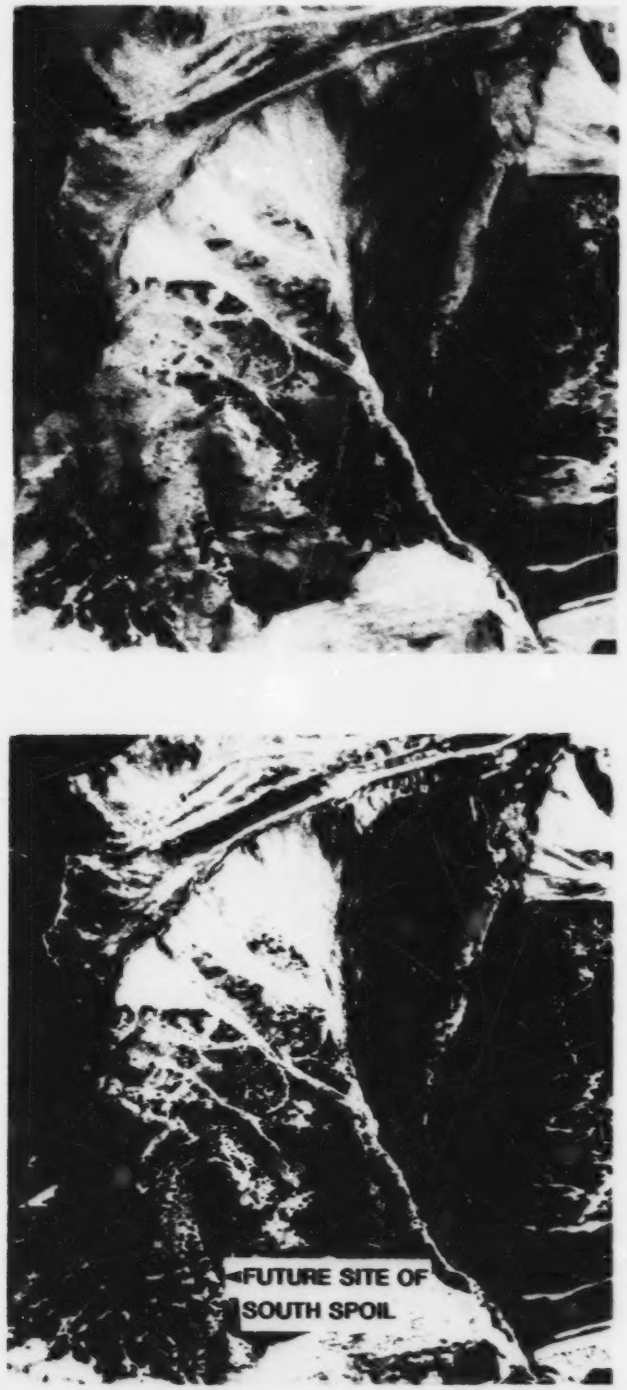
PROJECT NO. DRAWN REVIEWED DATE

FCL BLACKSTONE 06/17/85

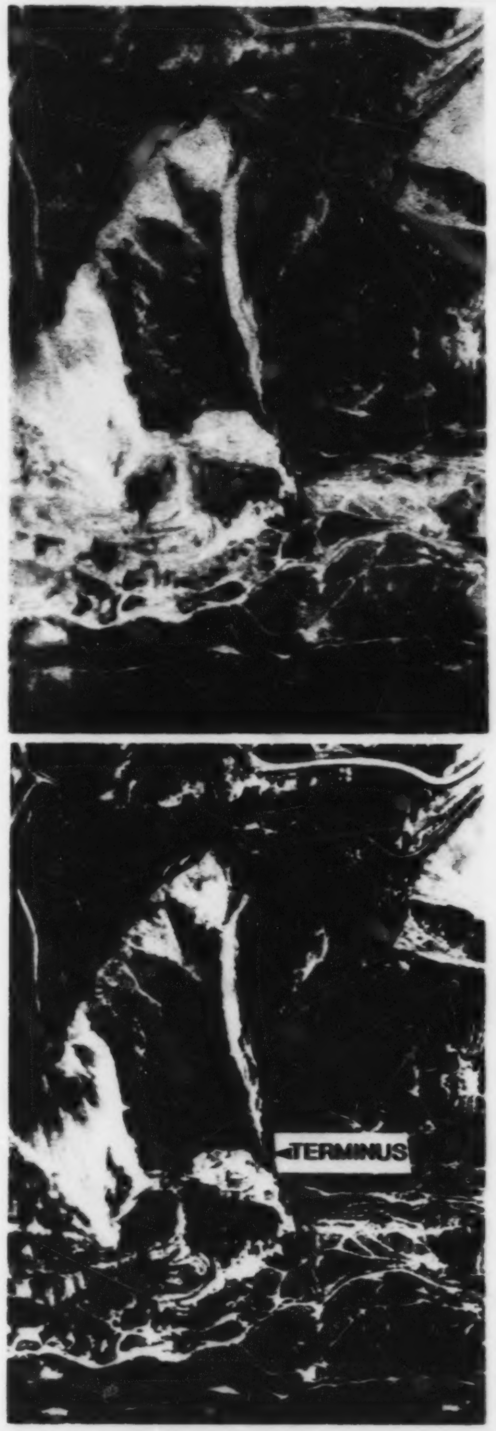
Figure 14P



BLACKSTONE GULLEY PRE - FAILURE


◄FUTURE SITE OF SOUTH SPOIL

EVENT 15 POST FAILURE

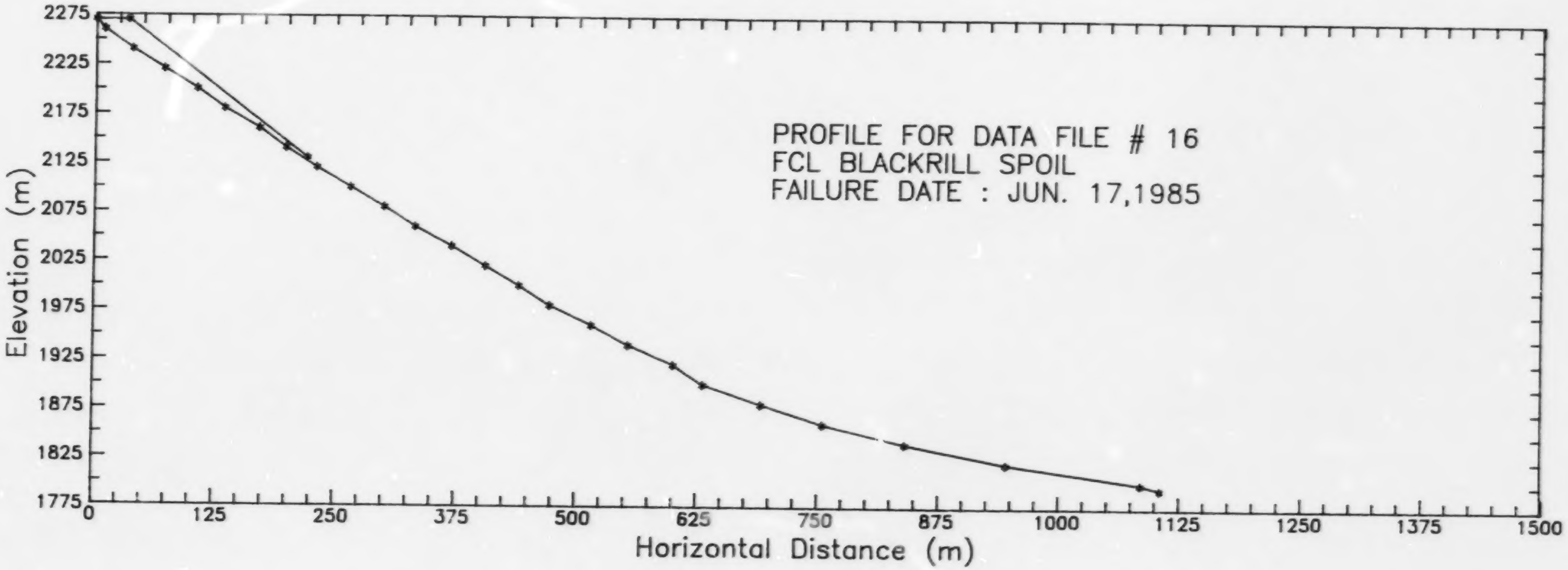


EVENT 14 POST FAILURE

PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept 91

FCL BLACKRILL 06/17/85

Figure 16 S



PROFILE FOR DATA FILE # 16
FCL BLACKRILL SPOIL
FAILURE DATE : JUN. 17,1985

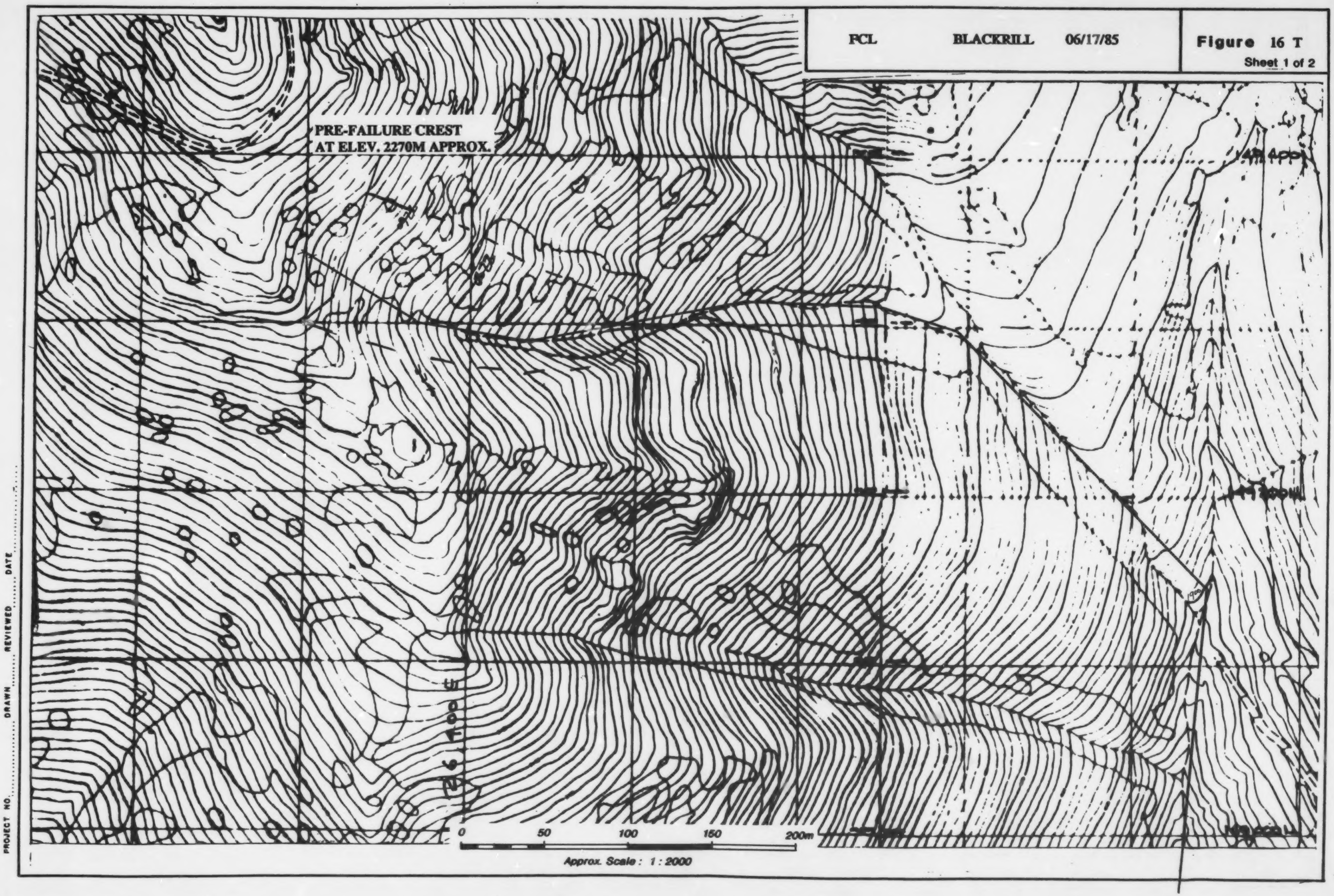
PROJECT NO. 912-1413 DRAWN ...... REVIEWED ...... DATE Sept '91

Golder Associates

FCL **BLACKRILL** **06/17/85**

Figure 16 T

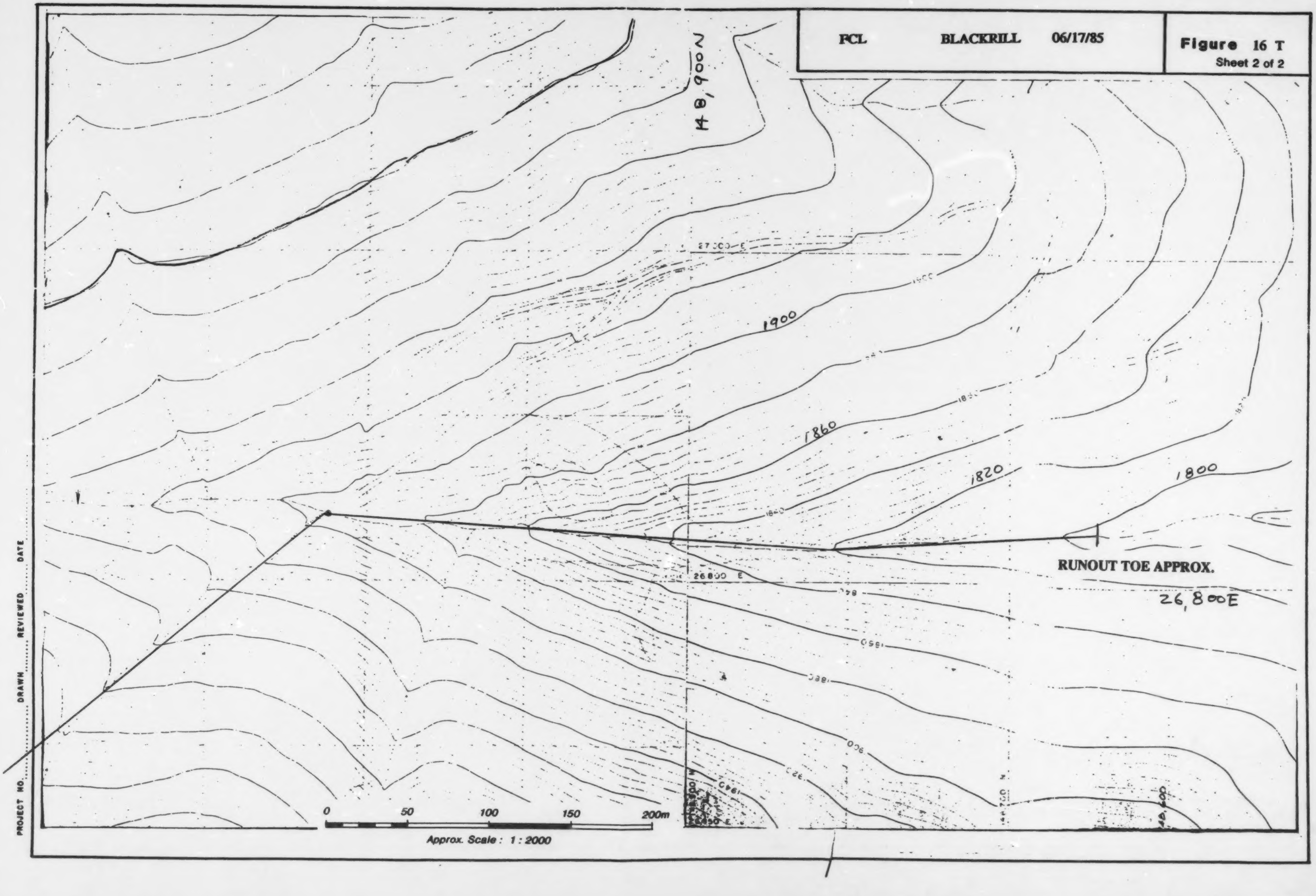
Sheet 1 of 2


PRE-FAILURE CREST
AT ELEV. 2270M APPROX.
14,400N
14,200N
14,000N
26,400E
1900
0
50
100
150
200m
Approx. Scale : 1 : 2000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE

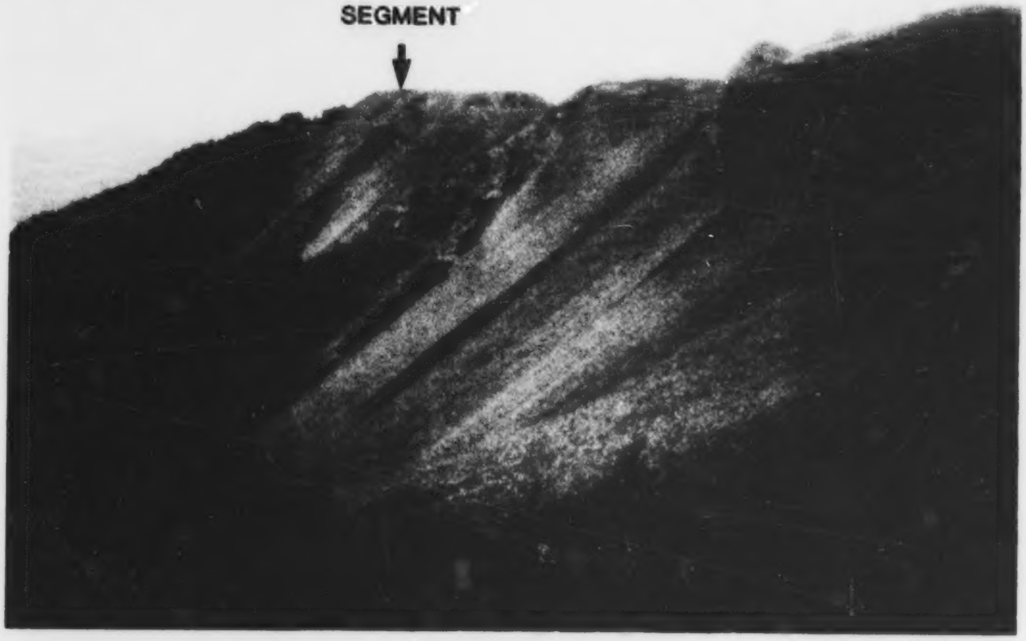
FCL BLACKRILL 06/17/85

Figure 16 T
Sheet 2 of 2

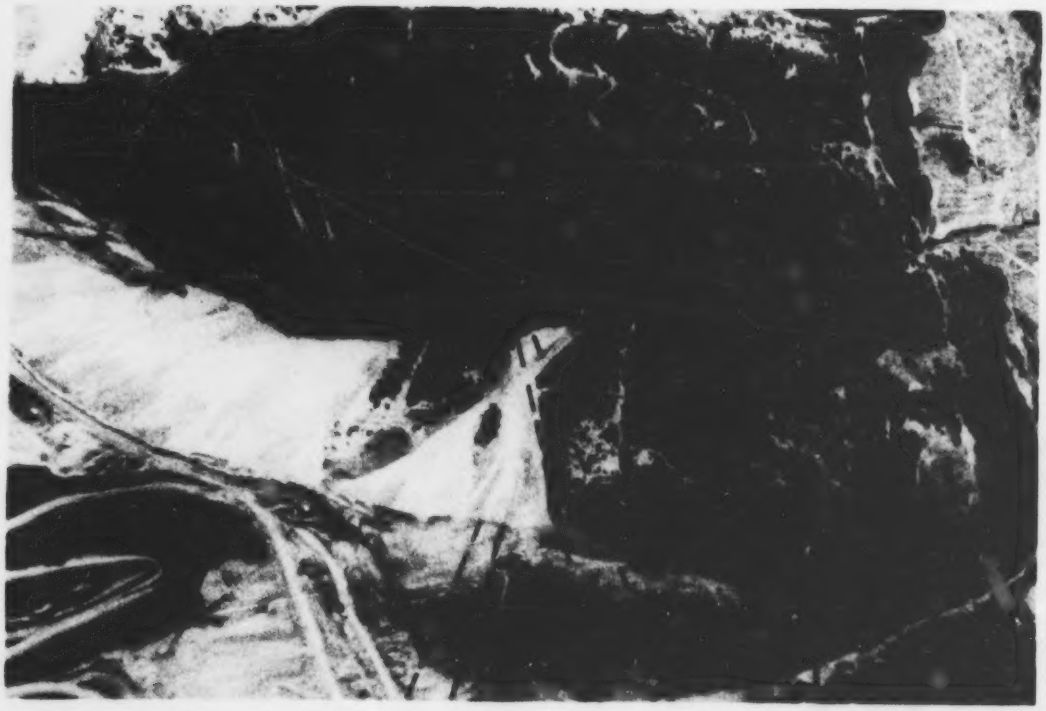

48,900N
27000 E
1900
1860
1820
1800
1840
26800 E
RUNOUT TOE APPROX.
26,800E
0
50
100
150
200m
Approx. Scale : 1 : 2000
PROJECT NO.
DRAWN
REVIEWED
DATE

FCL BLACKRILL 06/17/85	Figure 16 P

OCTOBER 1985


FAILED
SEGMENT

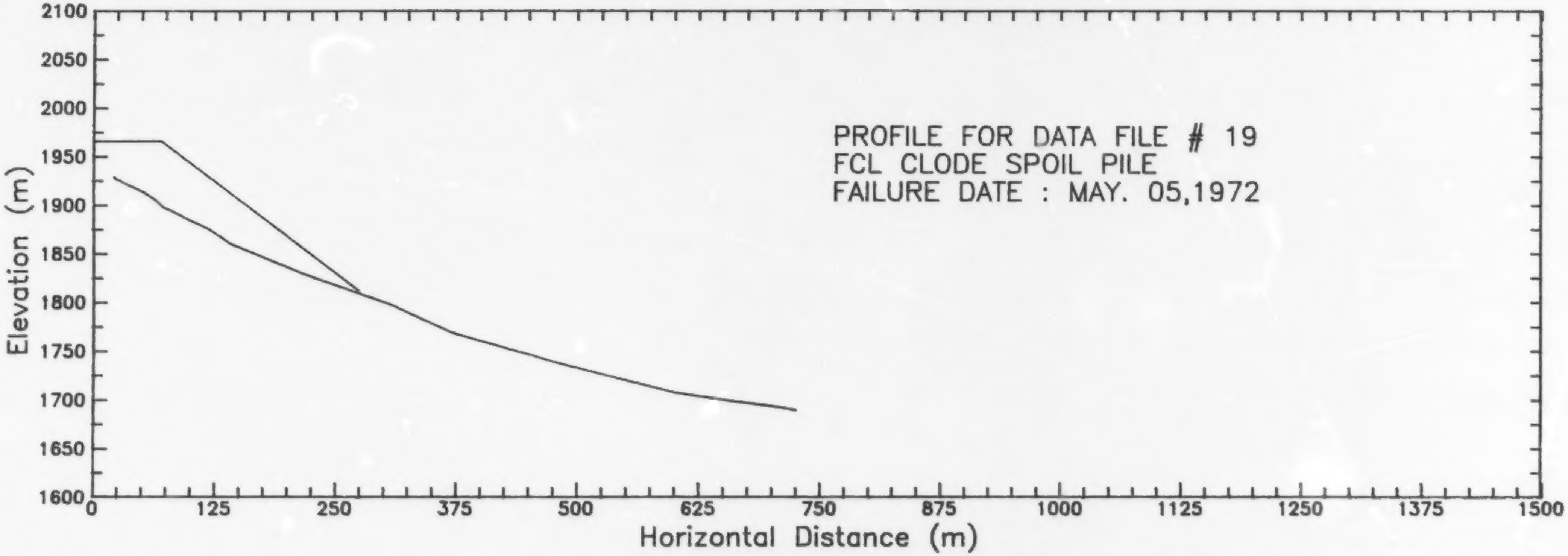
MID 1986


SLIDE
INITIATION
MAJOR
TURN POINT
APPROX.
TERMINUS

PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

FCL **2-SPOIL** **05/05/72**

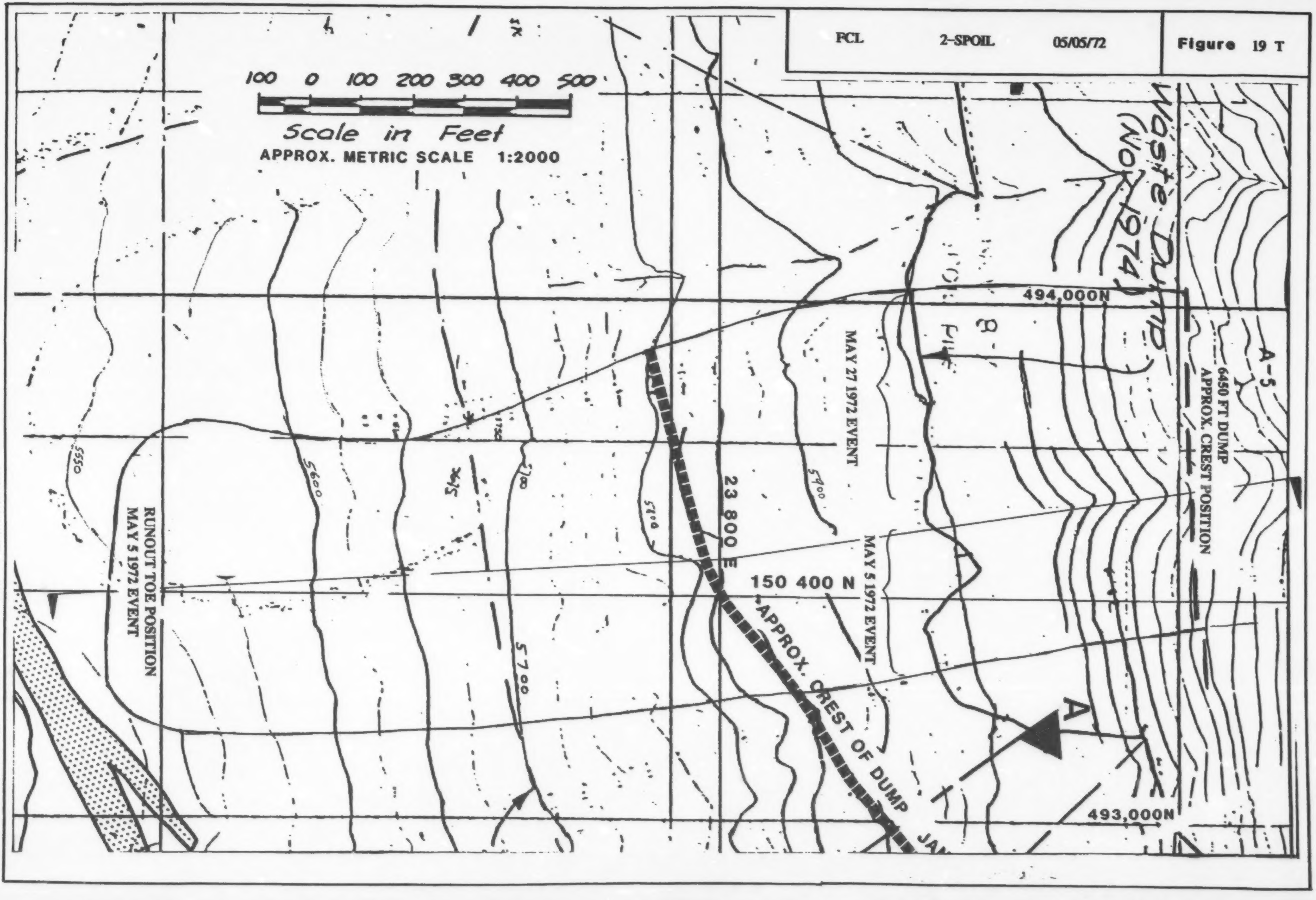
Figure 19 S


PROFILE FOR DATA FILE # 19
FCL CLODE SPOIL PILE
FAILURE DATE : MAY. 05,1972

PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

FCL 2-SPOIL 05/05/72

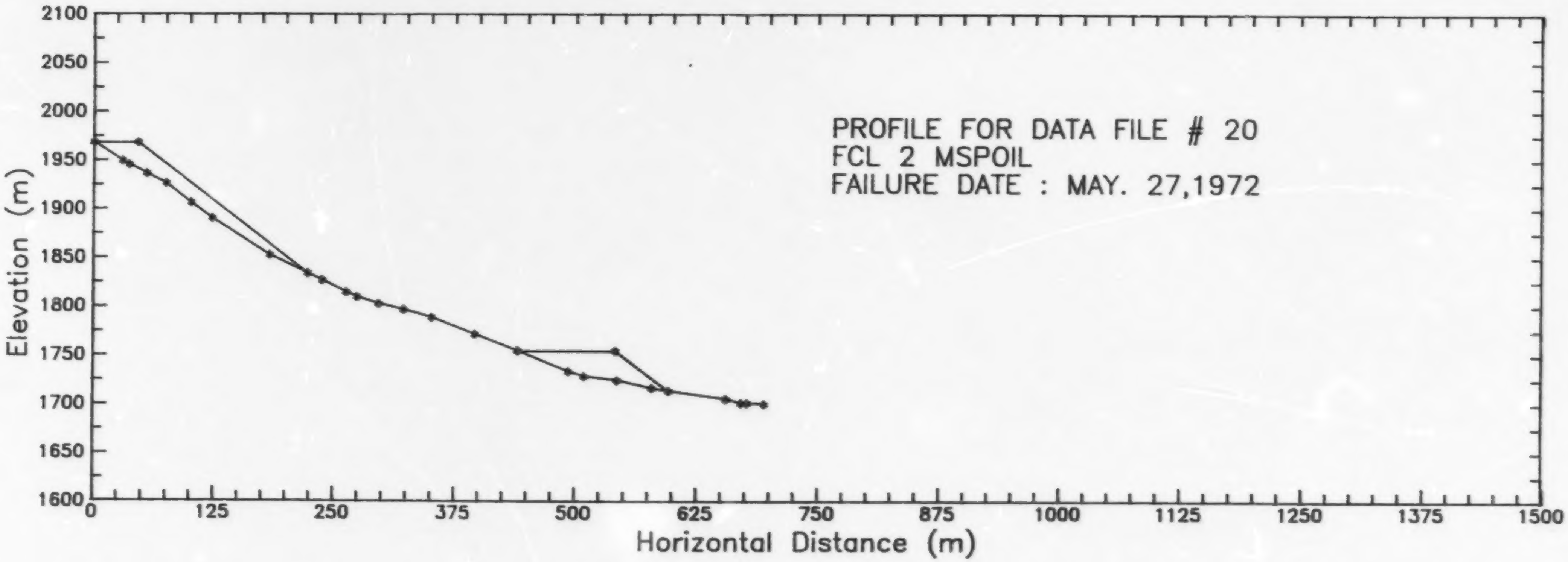
Figure 19 T


100 0 100 200 300 400 500
Scale in Feet
APPROX. METRIC SCALE 1:2000
Waste Dump (Nov 1974)
494,000N
493,000N
150 400 N
23 800 E
A-5
6450 FT DUMP
APPROX. CREST POSITION
MAY 27 1972 EVENT
MAY 5 1972 EVENT
RUNOUT TOE POSITION
MAY 5 1972 EVENT
APPROX. CREST OF DUMP
JA
A
5550
5600
5650
5700
5750
5800
5900

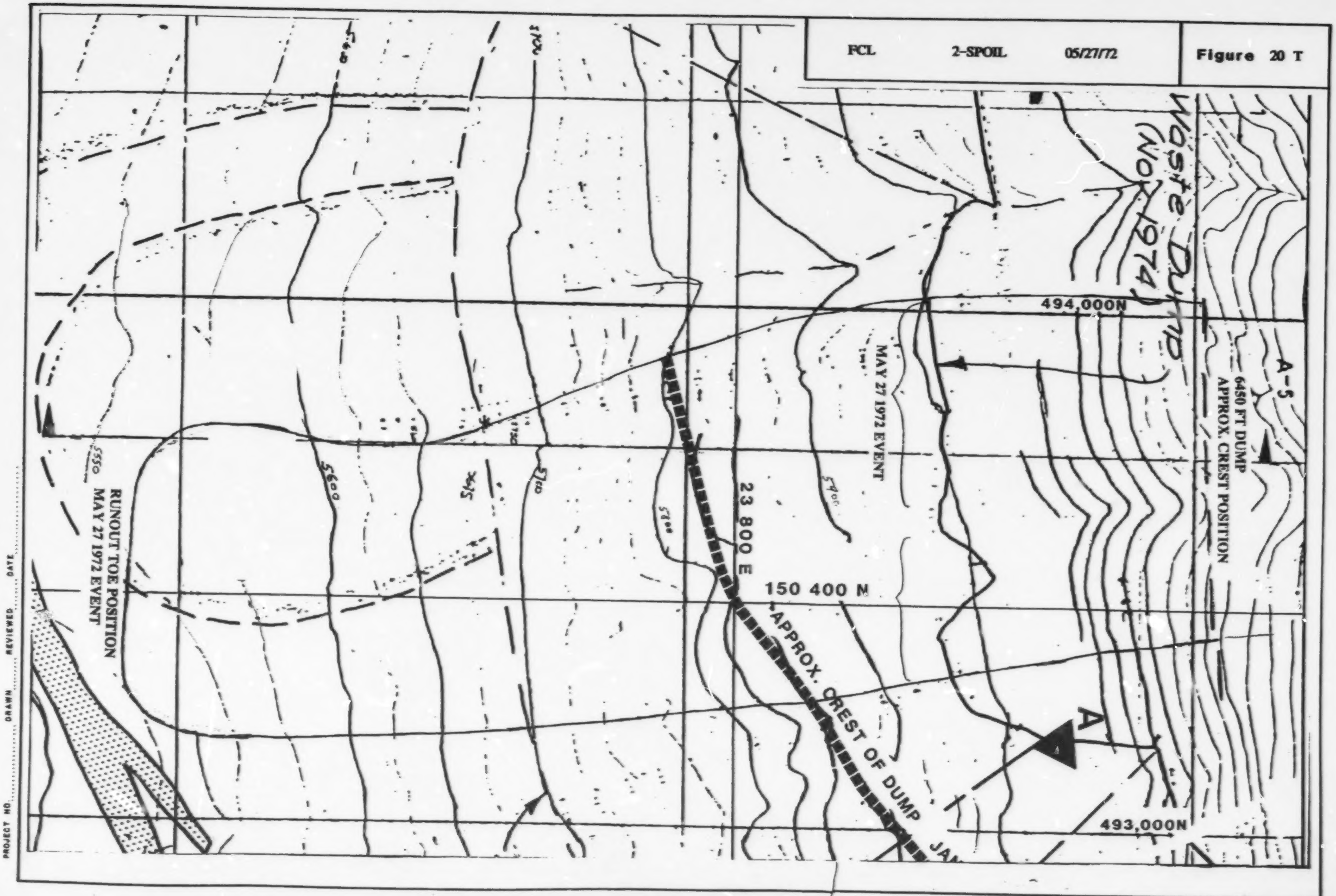
PROJECT NO. ______ DRAWN ______ REVIEWED ______ DATE ______

FCL 2-SPOIL 05/27/72

Figure 20 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

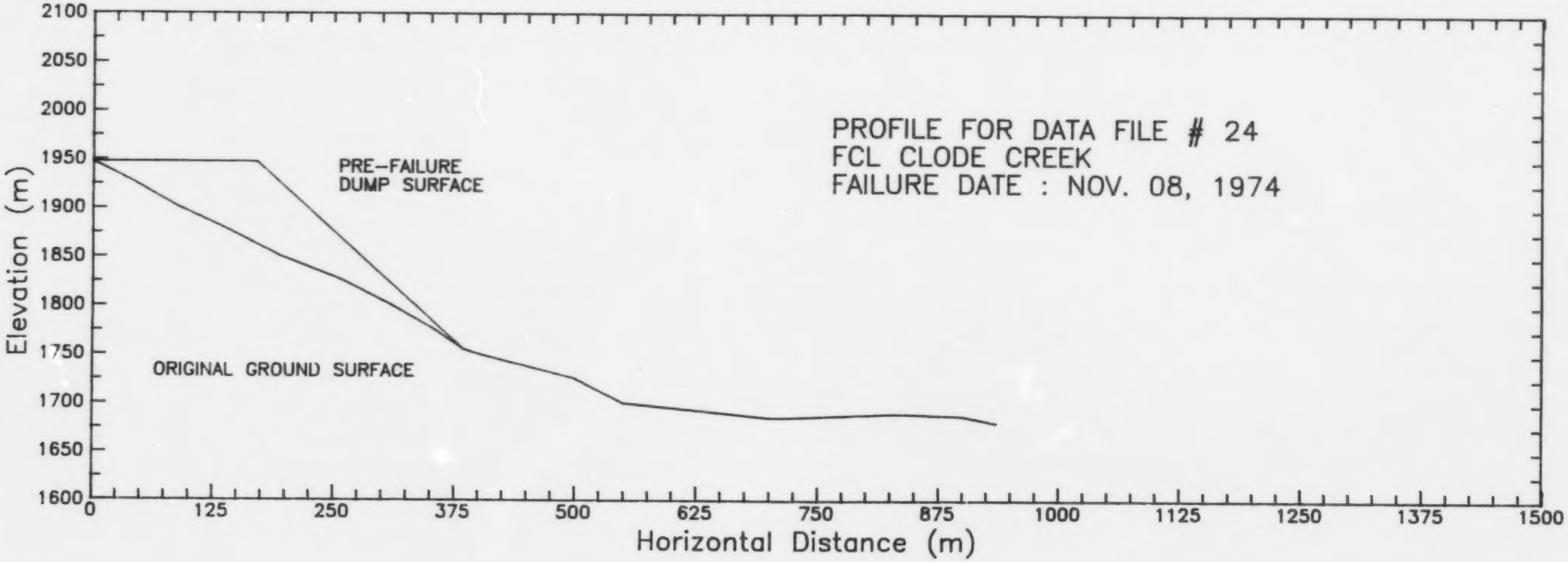

Waste Dump (NOR 1974)
A-5
6450 FT DUMP
APPROX. CREST POSITION
494,000N
MAY 27 1972 EVENT
5900
23 800 E
5800
150 400 M
APPROX. CREST OF DUMP
A
493,000N
5700
5650
5600
5550
RUNOUT TOE POSITION
MAY 27 1972 EVENT
PROJECT NO.
DRAWN
REVIEWED
DATE

FCL 2-SPOIL 05/27/72

Figure 20 T

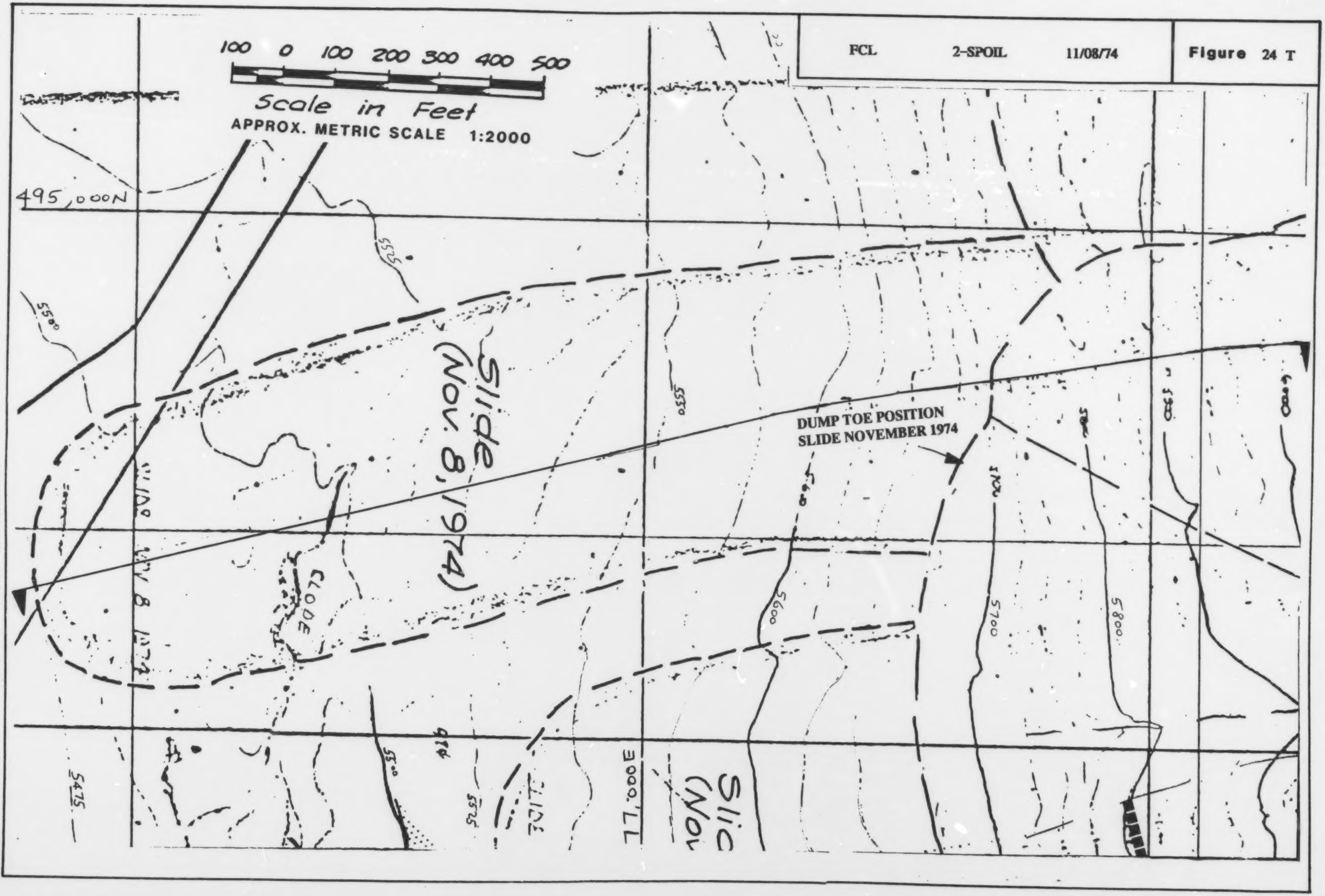
FCL 2-SPOIL 11/08/74

Figure 24 S



FCL 2-SPOIL 11/08/74

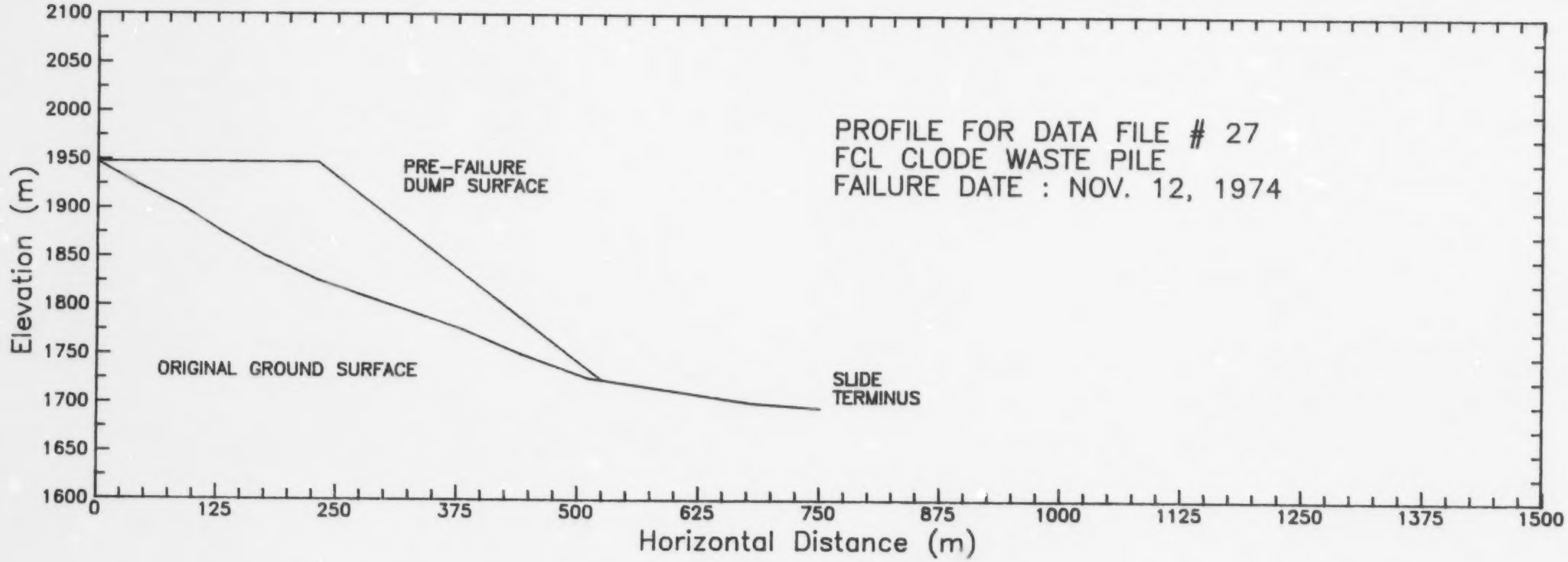
Figure 24 T


100 0 100 200 300 400 500
Scale in Feet
APPROX. METRIC SCALE 1:2000
495,000N
77,000E
Slide (Nov 8, 1974)
Slide (Nov 8 1974)
Slic (Nov
SLIDE
CLODE
DUMP TOE POSITION
SLIDE NOVEMBER 1974
5475
5500
5525
5550
5600
5700
5800
5900
6000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

FCL 2-SPOIL 11/12/74

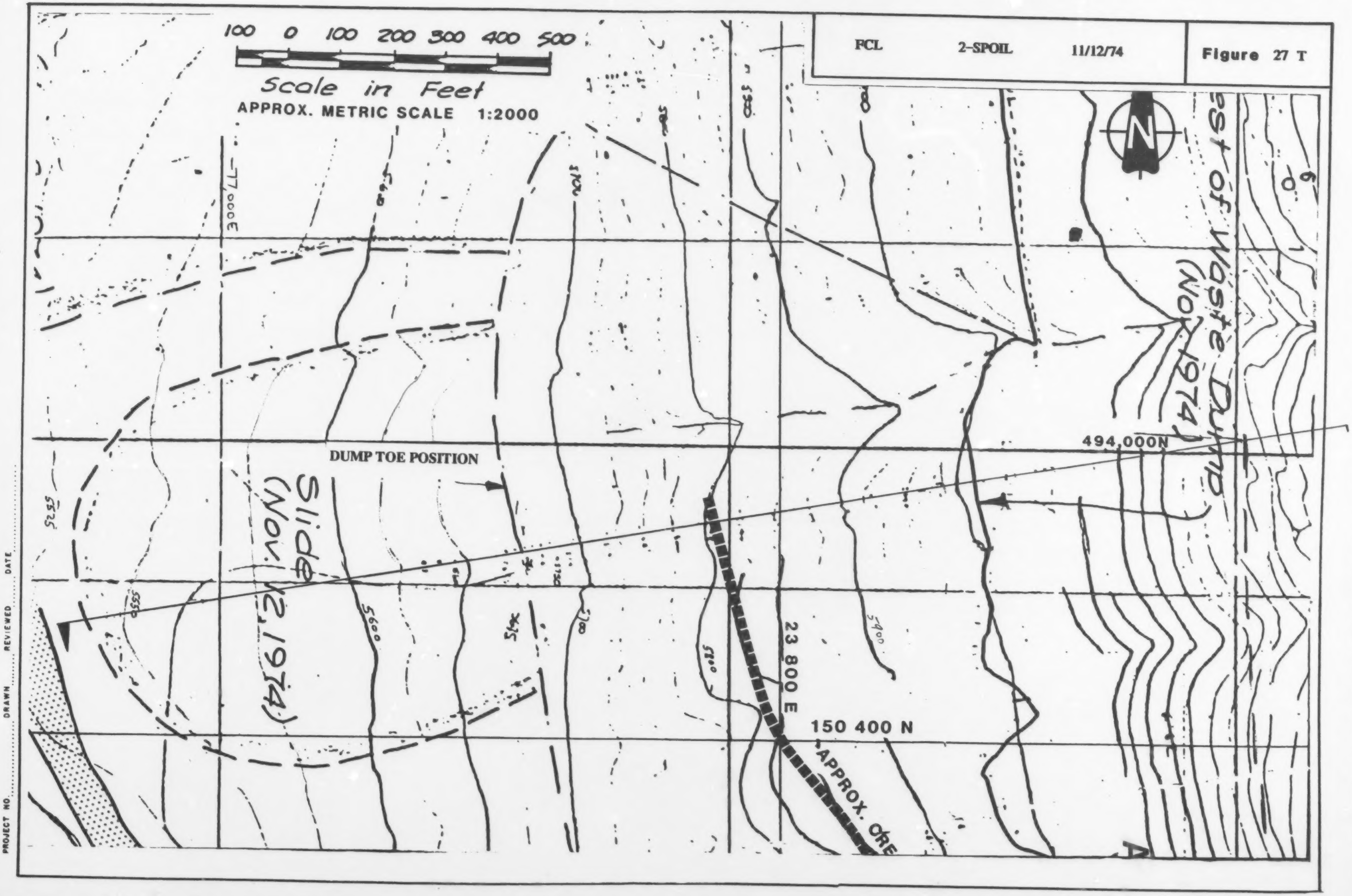
Figure 27 S



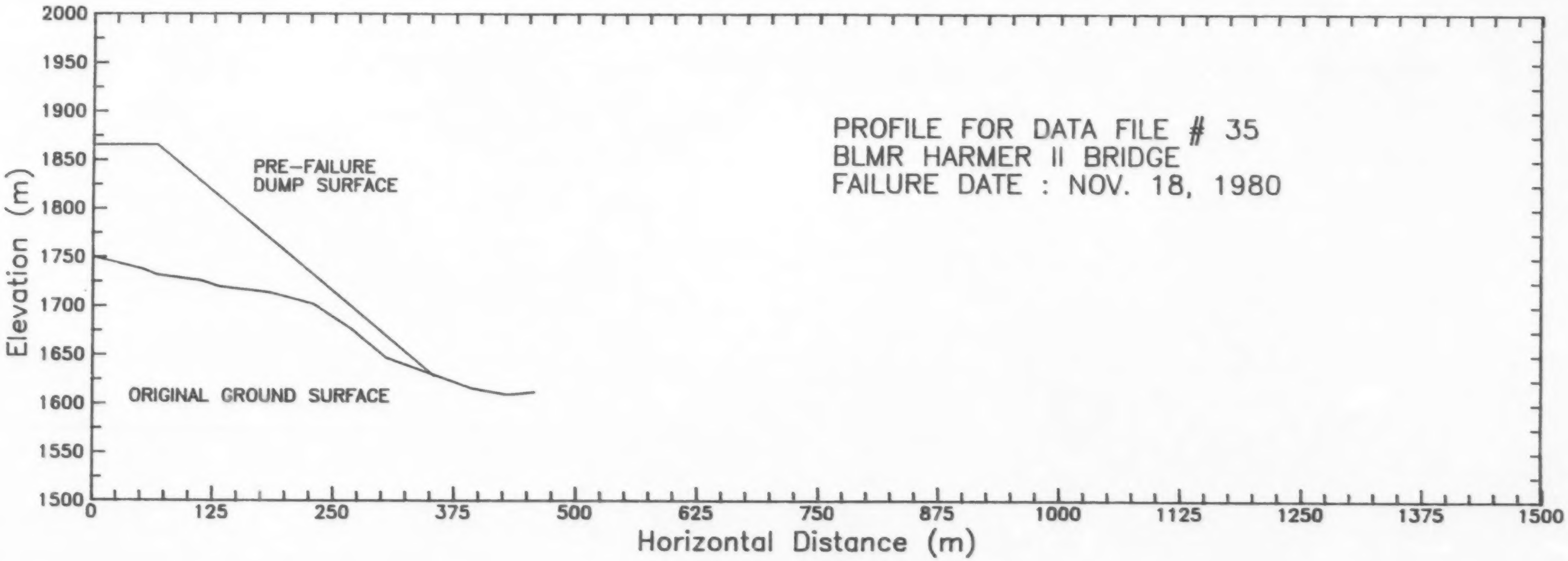
PROJECT NO. 912-14/3 DRAWN ...... REVIEWED ...... DATE Sept. '91

FCL 2-SPOIL 11/12/74

Figure 27 T


100 0 100 200 300 400 500
Scale in Feet
APPROX. METRIC SCALE 1:2000
N
DUMP TOE POSITION
Slide (Nov 12, 1974)
est of Waste Dump (Nov 1974)
494,000N
23 800 E
150 400 N
APPROX. ORE
5600
5700
5800
5900
5550
5525

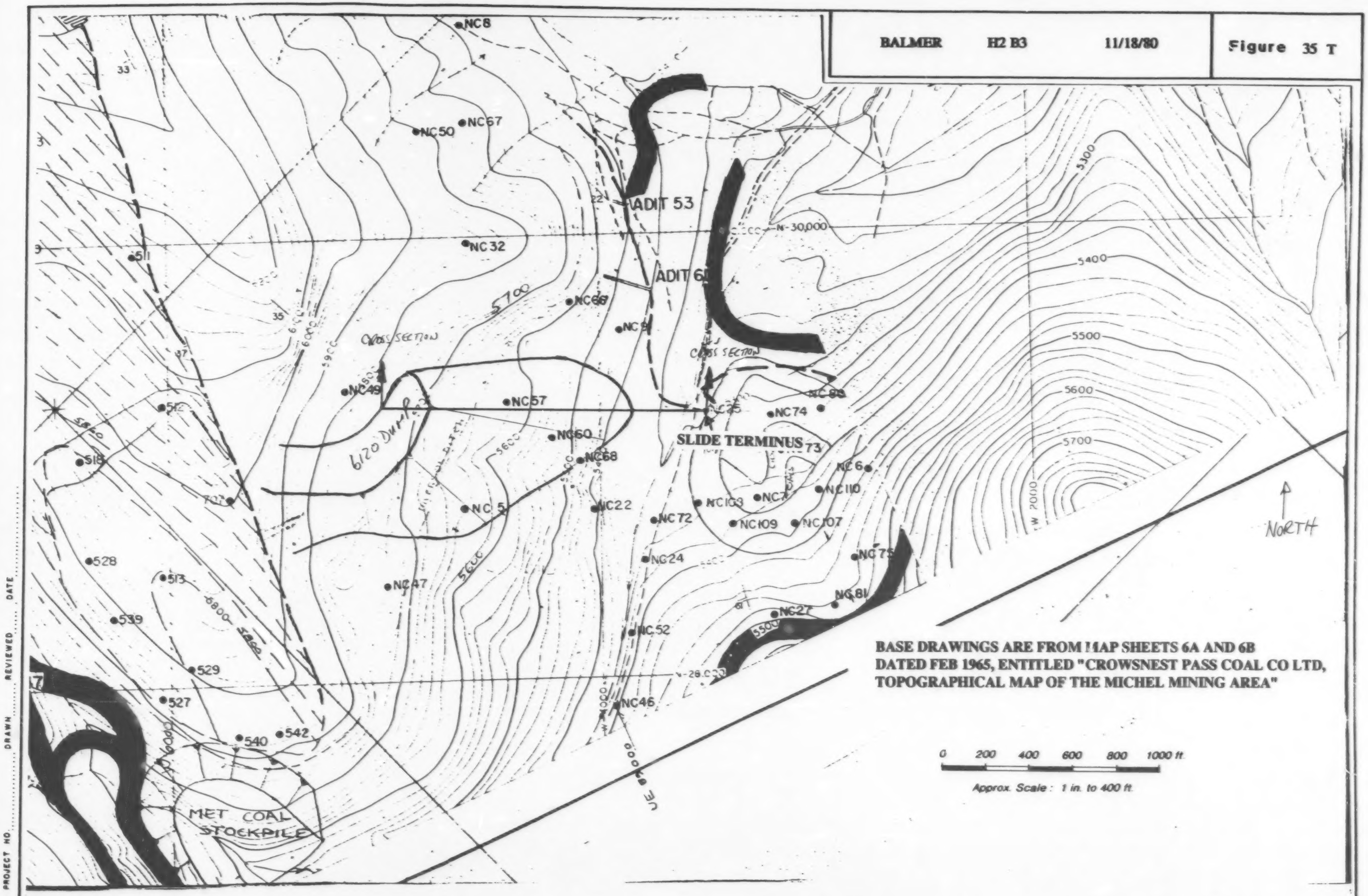
PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....



PROJECT NO. 912-14/3 DRAWN .... REVIEWED .... DATE Sept. '91

BALMER H2 B3 11/18/80

Figure 35 T


NC8
33
3
NC50
NC67
ADIT 53
22
N-30,000
NC32
511
ADIT 61
5700
NC66
NC9
35
6000
37
CROSS SECTION
CROSS SECTION
NC49
NC57
512
6120 DUMP
NC60
NC68
NC25
NC74
NC89
SLIDE TERMINUS
73
NC6
NC110
518
5600
NC 5
NC22
NC72
NC103
NC7
NC109
NC107
528
NC24
NC75
513
NC47
5600
5800
NC81
NC27
539
NC52
5500
529
N-28,000
527
NC46
540
542
MET COAL STOCKPILE
UE 8000
5300
5400
5500
5600
5700
W 2000
NORTH

BASE DRAWINGS ARE FROM MAP SHEETS 6A AND 6B DATED FEB 1965, ENTITLED "CROWSNEST PASS COAL CO LTD, TOPOGRAPHICAL MAP OF THE MICHEL MINING AREA"

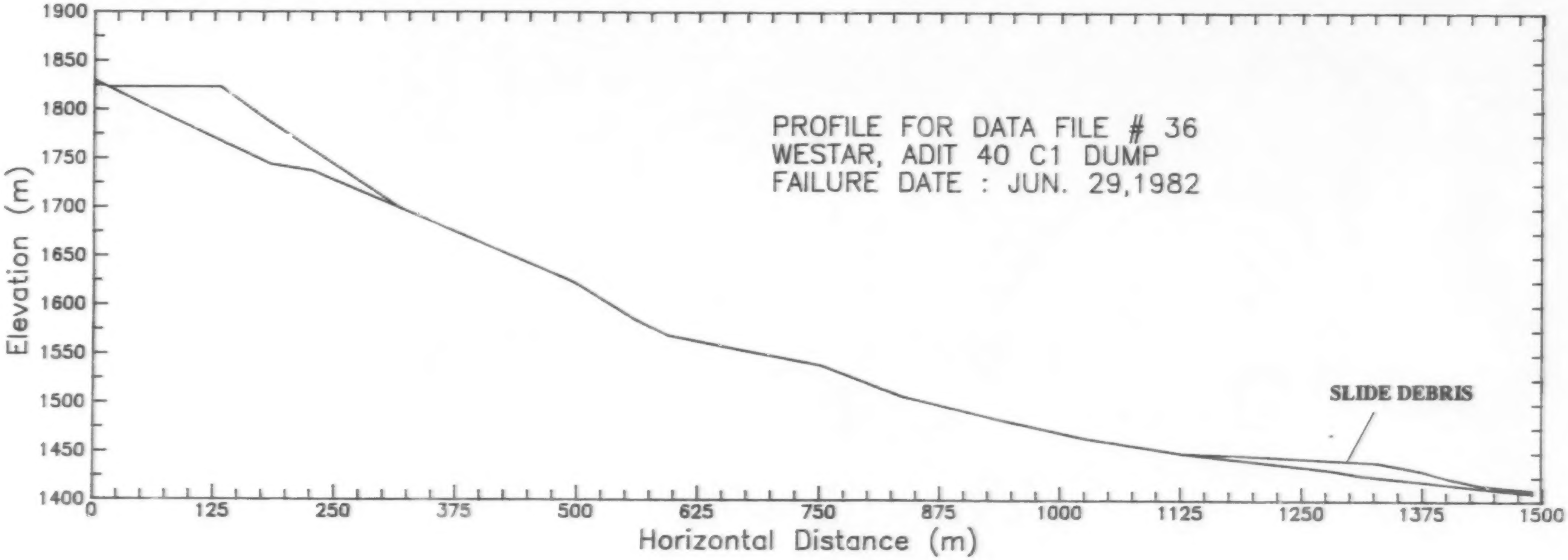
0 200 400 600 800 1000 ft.

Approx. Scale : 1 in. to 400 ft.

PROJECT NO. .... DRAWN .... REVIEWED .... DATE

BALMER A40-C1 06/29/82

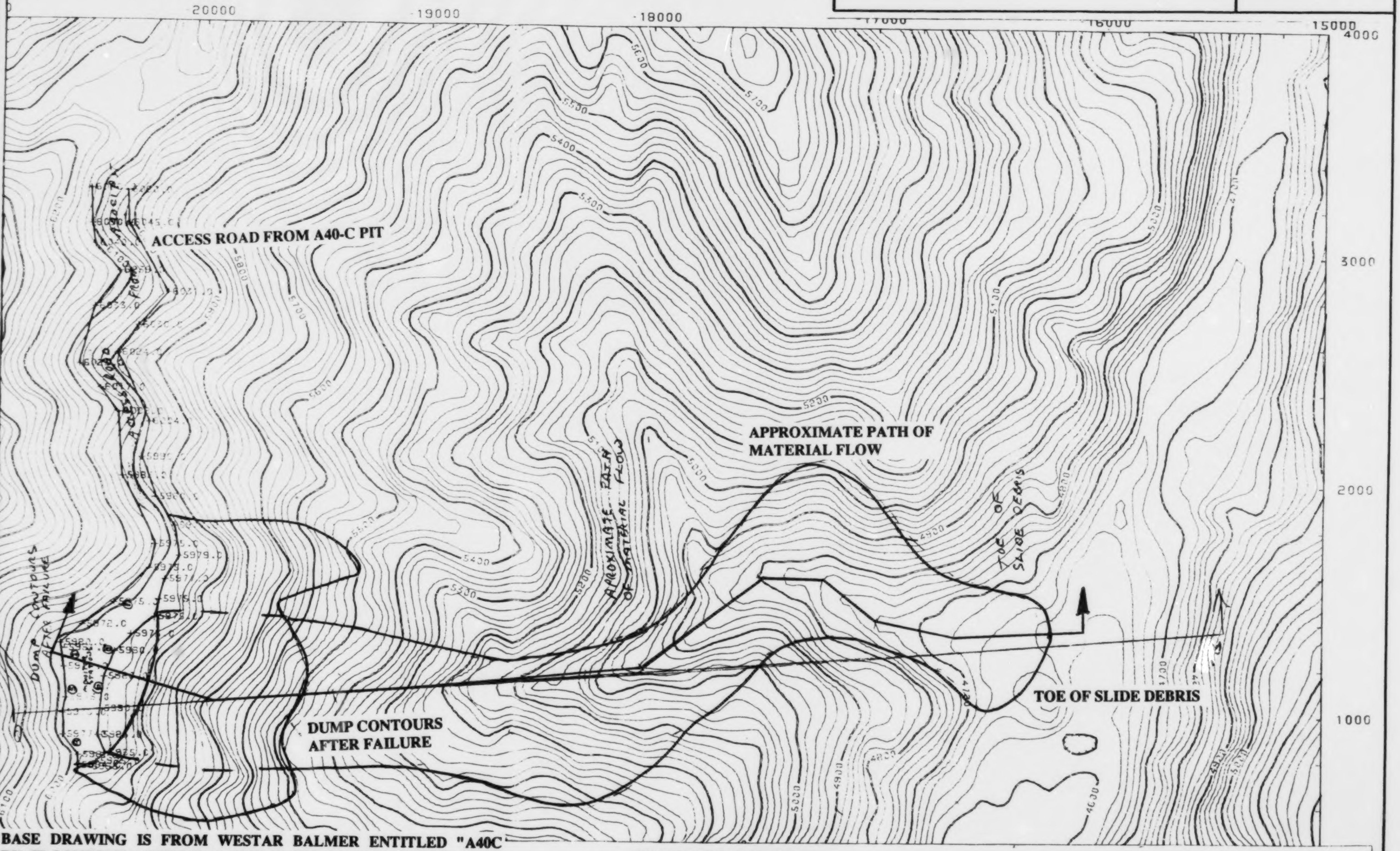
Figure 36 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

BALMER A40–C1 06/29/82

Figure 36 T

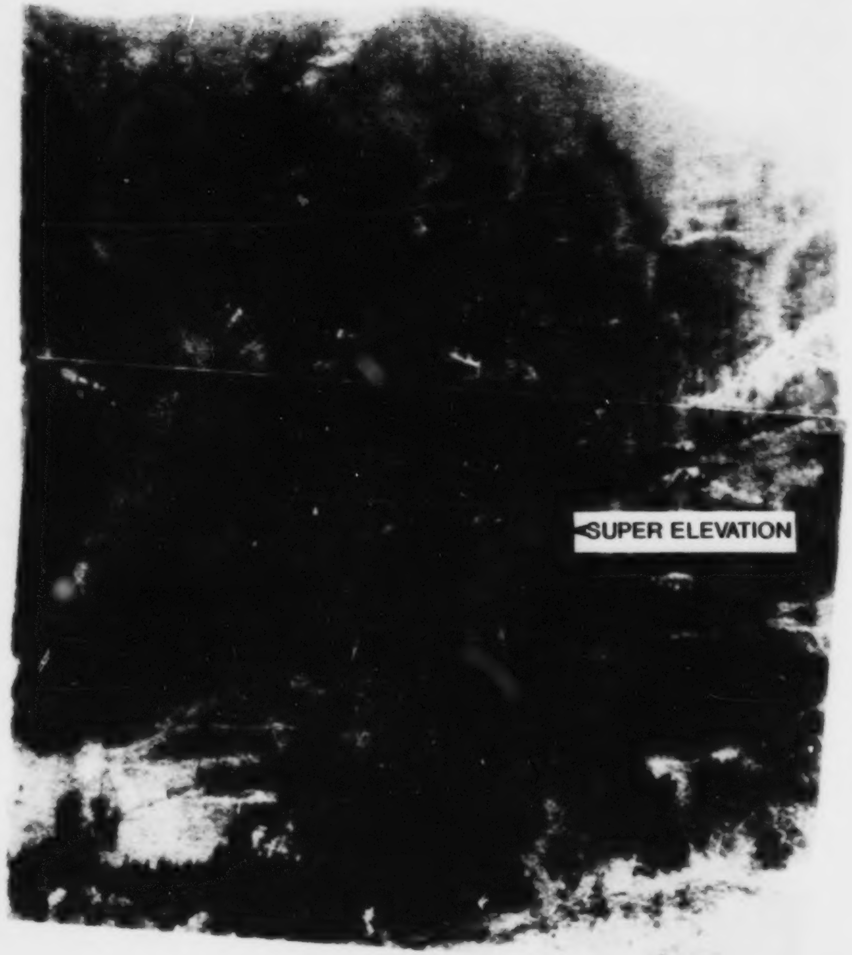


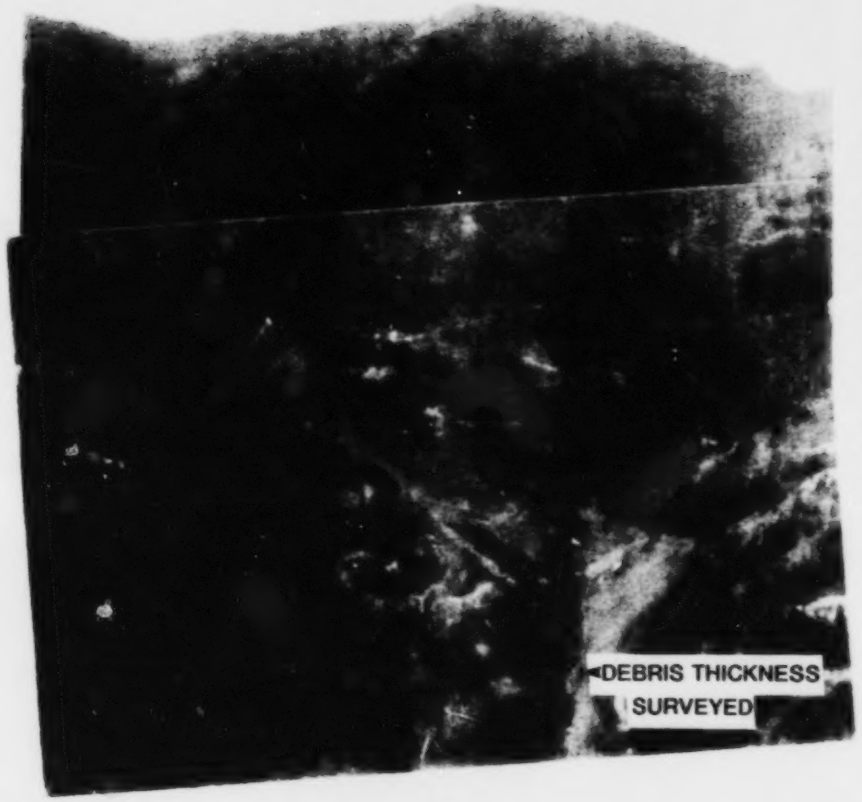
20000
19000
18000
17000
16000
15000
4000
3000
2000
1000
ACCESS ROAD FROM A40-C PIT
APPROXIMATE PATH OF MATERIAL FLOW
TOE OF SLIDE DEBRIS
DUMP CONTOURS AFTER FAILURE
DUMP CONTOURS AFTER FAILURE
ACCESS ROAD FROM A40-C PIT
APPROXIMATE PATH OF MATERIAL FLOW
TOE OF SLIDE DEBRIS
5500
5400
5300
5200
5100
5000
4900
4800
4700
4600
6100

BASE DRAWING IS FROM WESTAR BALMER ENTITLED "A40C DUMP CONTOUR (AFTER FAILURE) PLOT NO. 2 07/06/82 TIME 10.30"

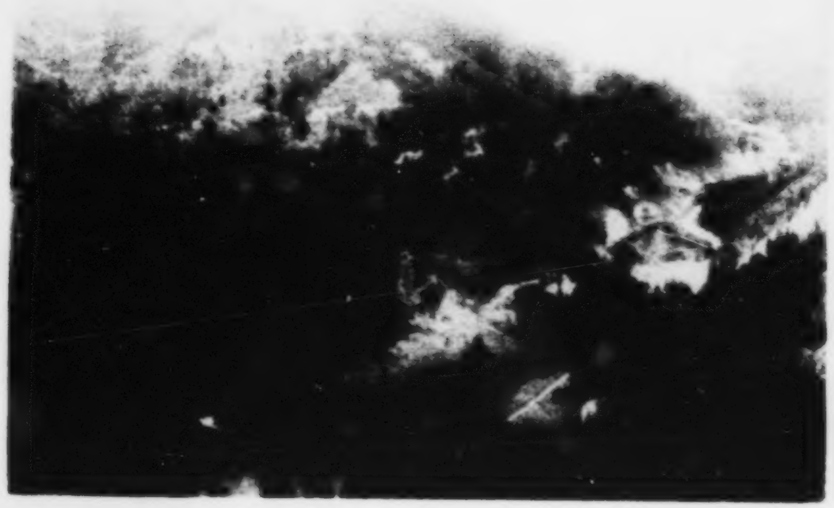
SCALE 1 INCH TO 400 FT

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

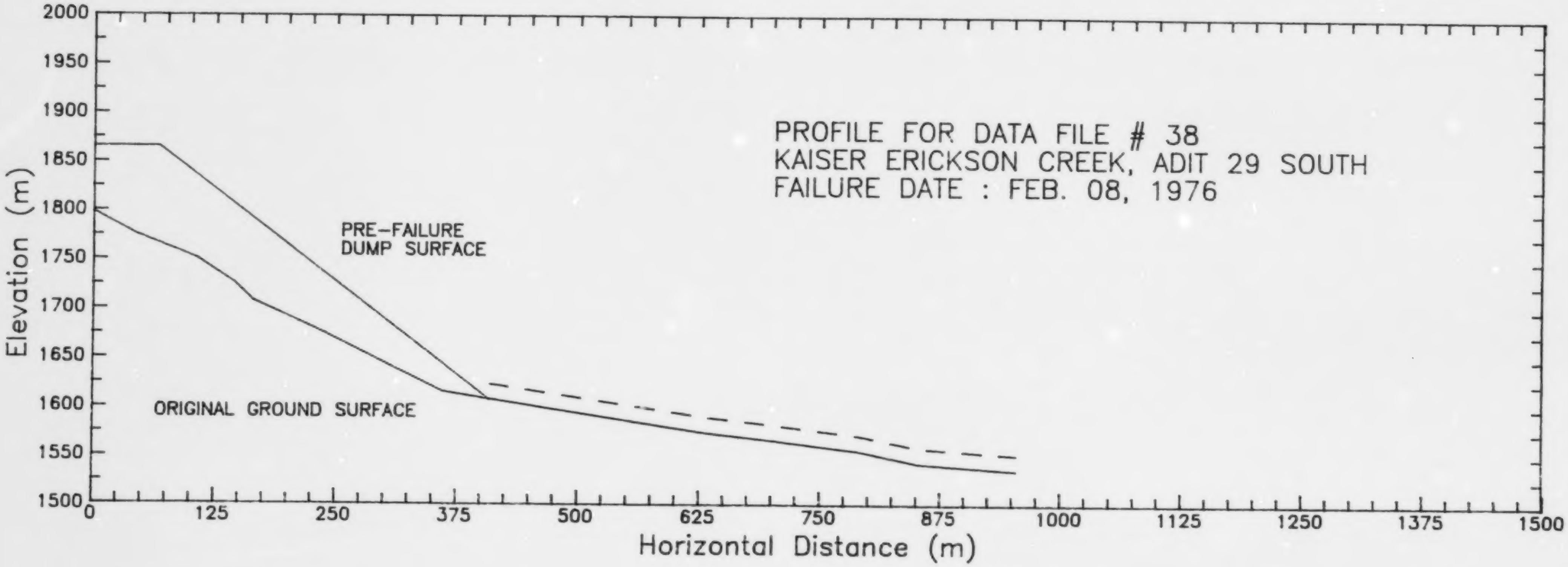

SUPER ELEVATION


DEBRIS THICKNESS
SURVEYED

SUPER ELEVATION



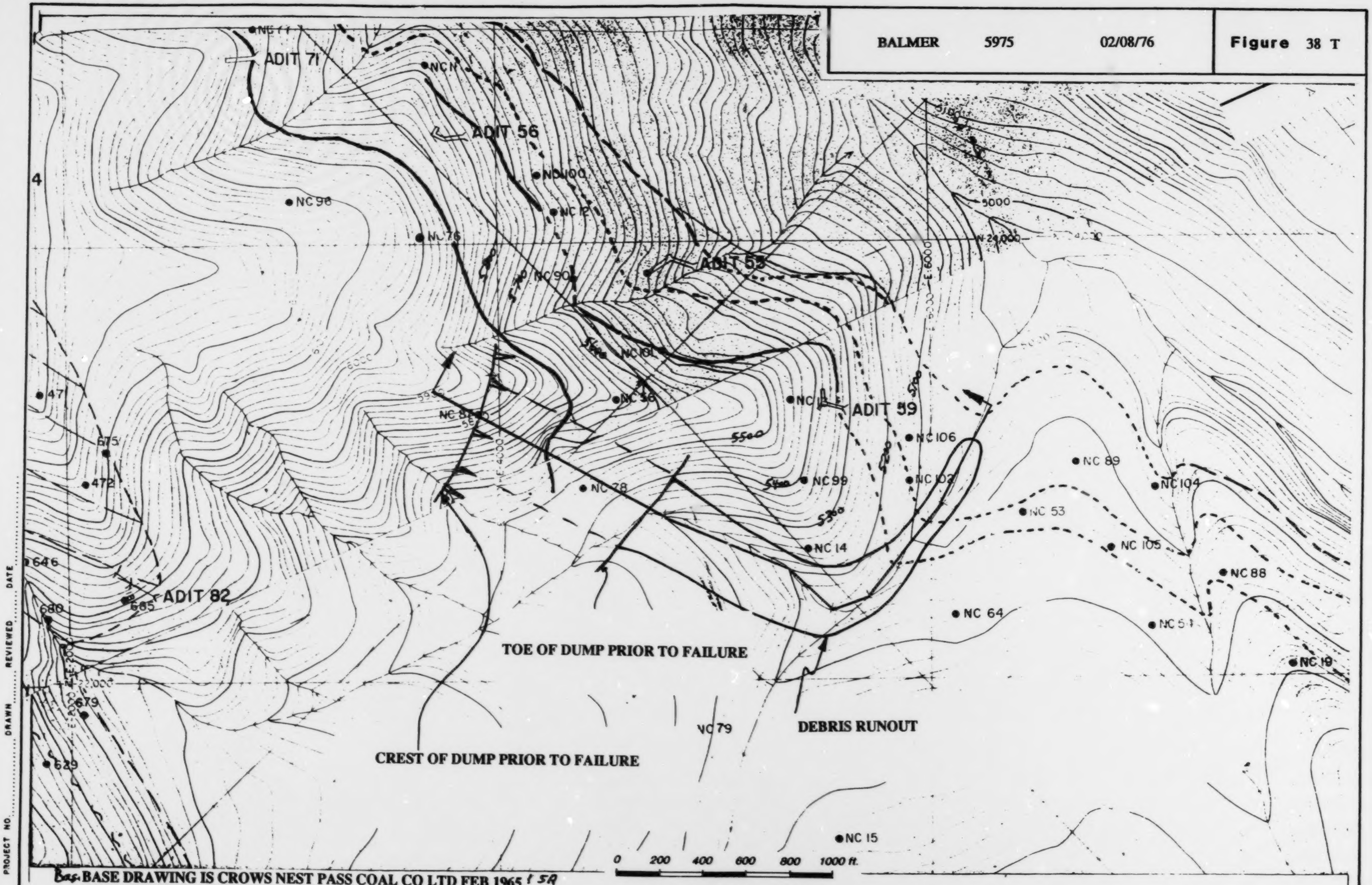
BALMER 5975 02/08/76 | **Figure** 38 S



PROJECT NO 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

BALMER 5975 02/08/76

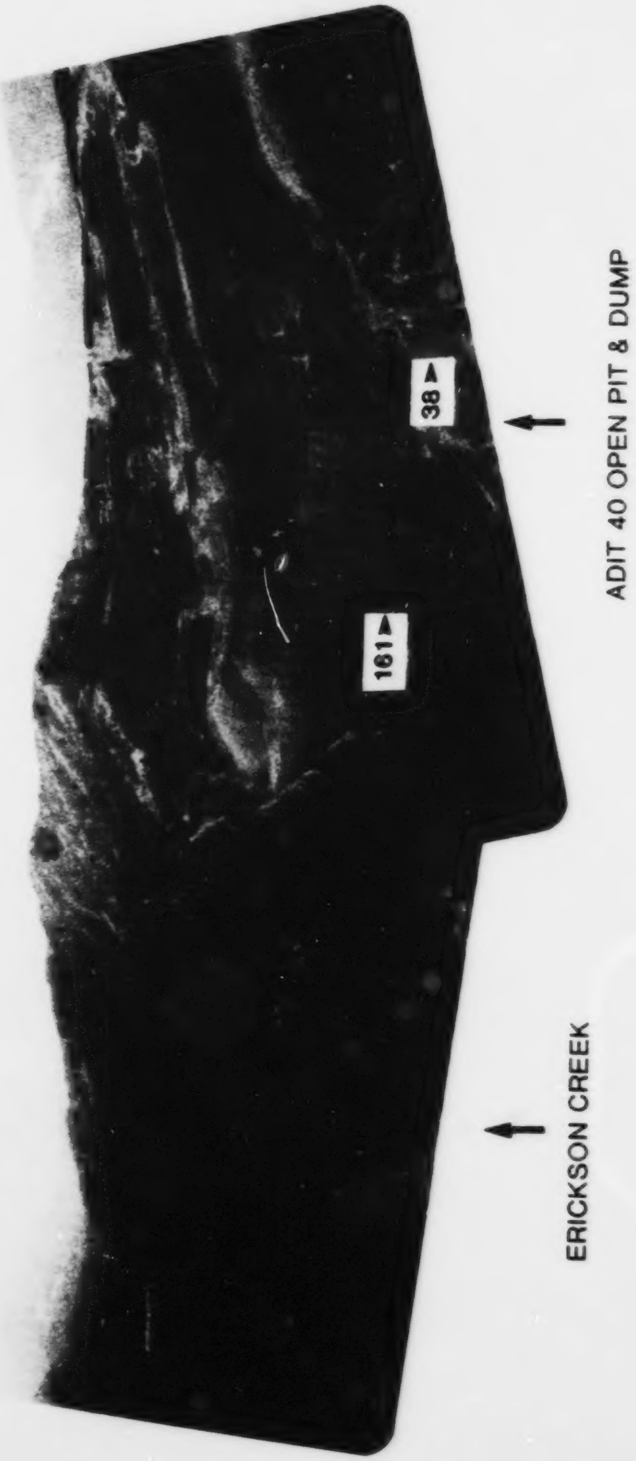
Figure 38 T


NC 77
ADIT 71
NC 11
ADIT 56
ND 100
NC 96
NC 12
NC 76
NC 90
ADIT 55
5100
5000
N 21,000
E 6000
4000
5000
6000
NC 101
NC 36
NC 82
ADIT 59
NC 106
5500
NC 89
NC 99
NC 102
NC 104
NC 78
NC 53
NC 14
NC 105
NC 88
NC 64
NC 51
NC 19
47
675
472
646
ADIT 82
665
680
679
629
4
TOE OF DUMP PRIOR TO FAILURE
DEBRIS RUNOUT
CREST OF DUMP PRIOR TO FAILURE
NC 79
NC 15
0 200 400 600 800 1000 ft.
Approx. Scale : 1 in. to 400 ft.
PROJECT NO.
DRAWN
REVIEWED
DATE

BASE DRAWING IS CROWS NEST PASS COAL CO LTD FEB 1965
SHT 4A AND 5A

BALMER 5975 02/08/76

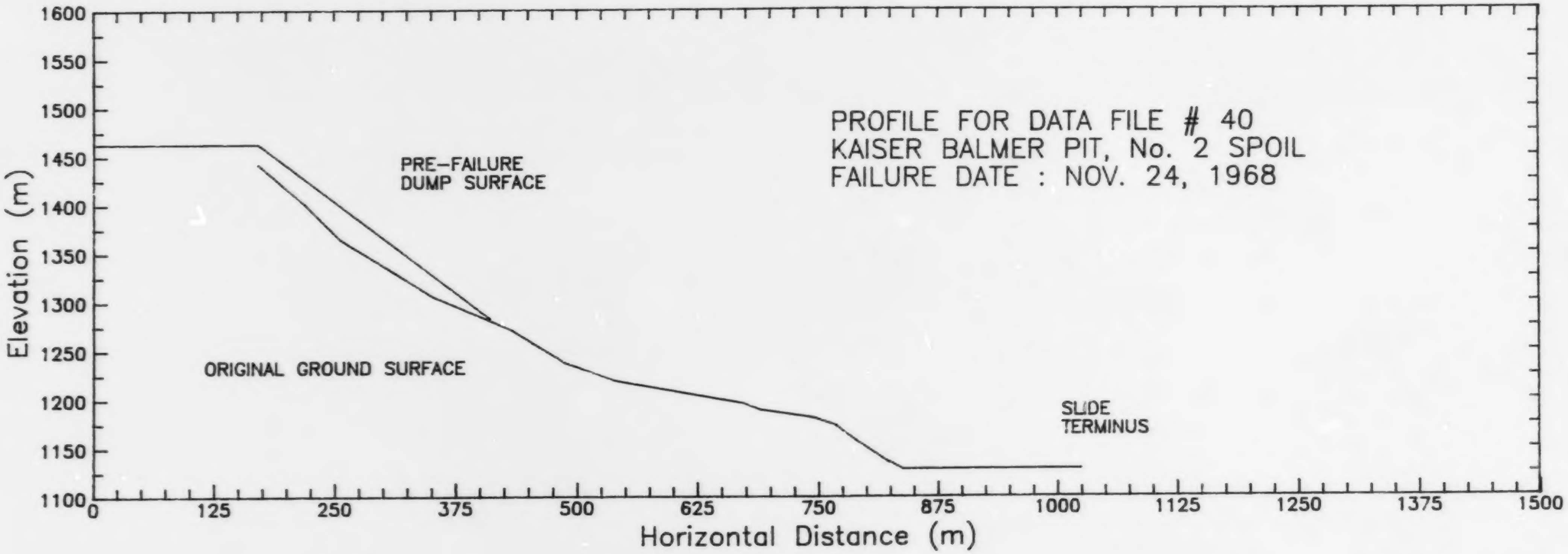
Figure **38 P**


ADIT 40 OPEN PIT & DUMP
38
161
ERICKSON CREEK

PROJECT NO .... DRAWN .... REVIEWED .... DATE ....

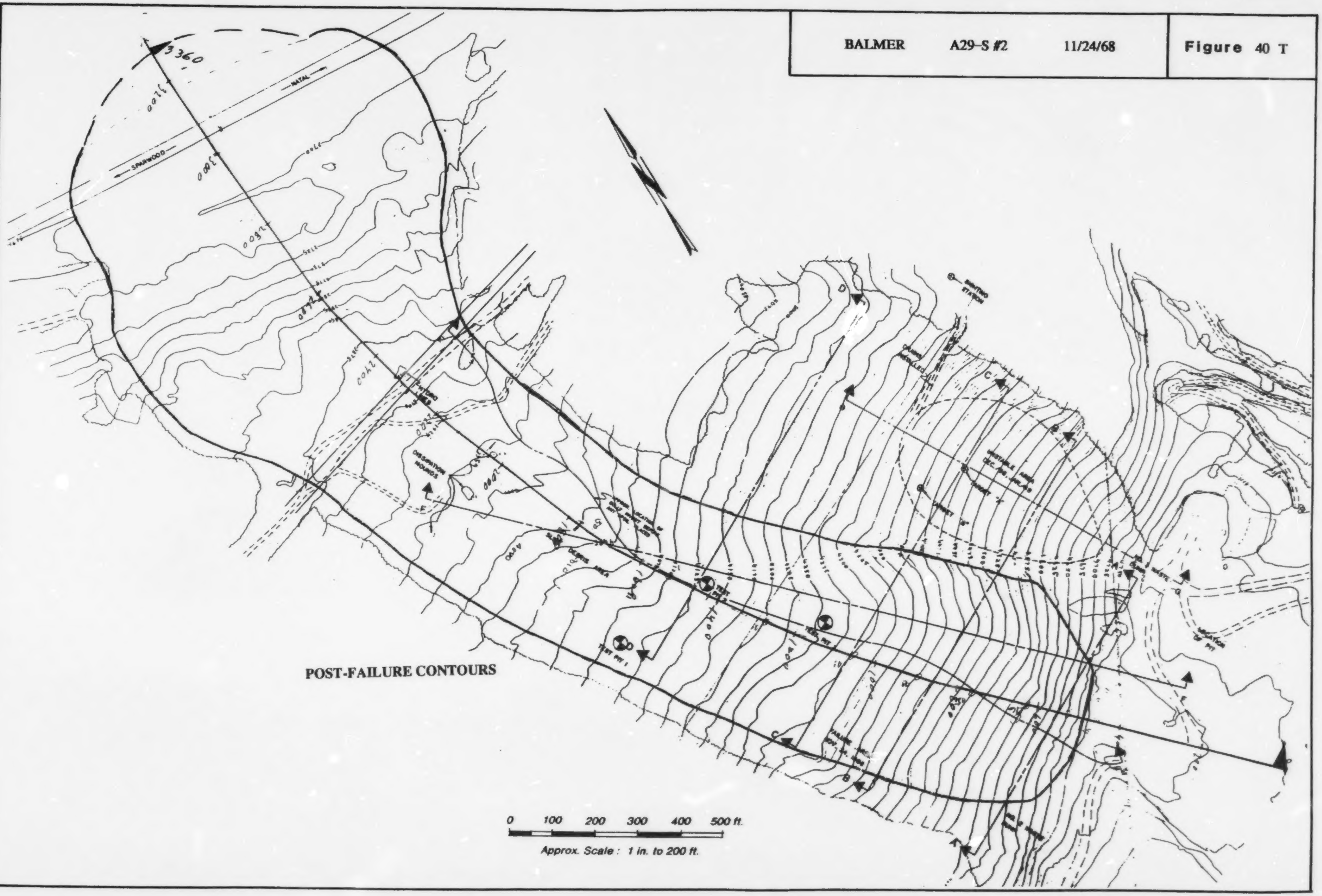
BALMER A29-S #2 11/24/68

Figure 40 S



PROJECT NO. 912-14/3 DRAWN .... REVIEWED .... DATE Sept. '91

BALMER A29-S #2 11/24/68 | **Figure 40 T**

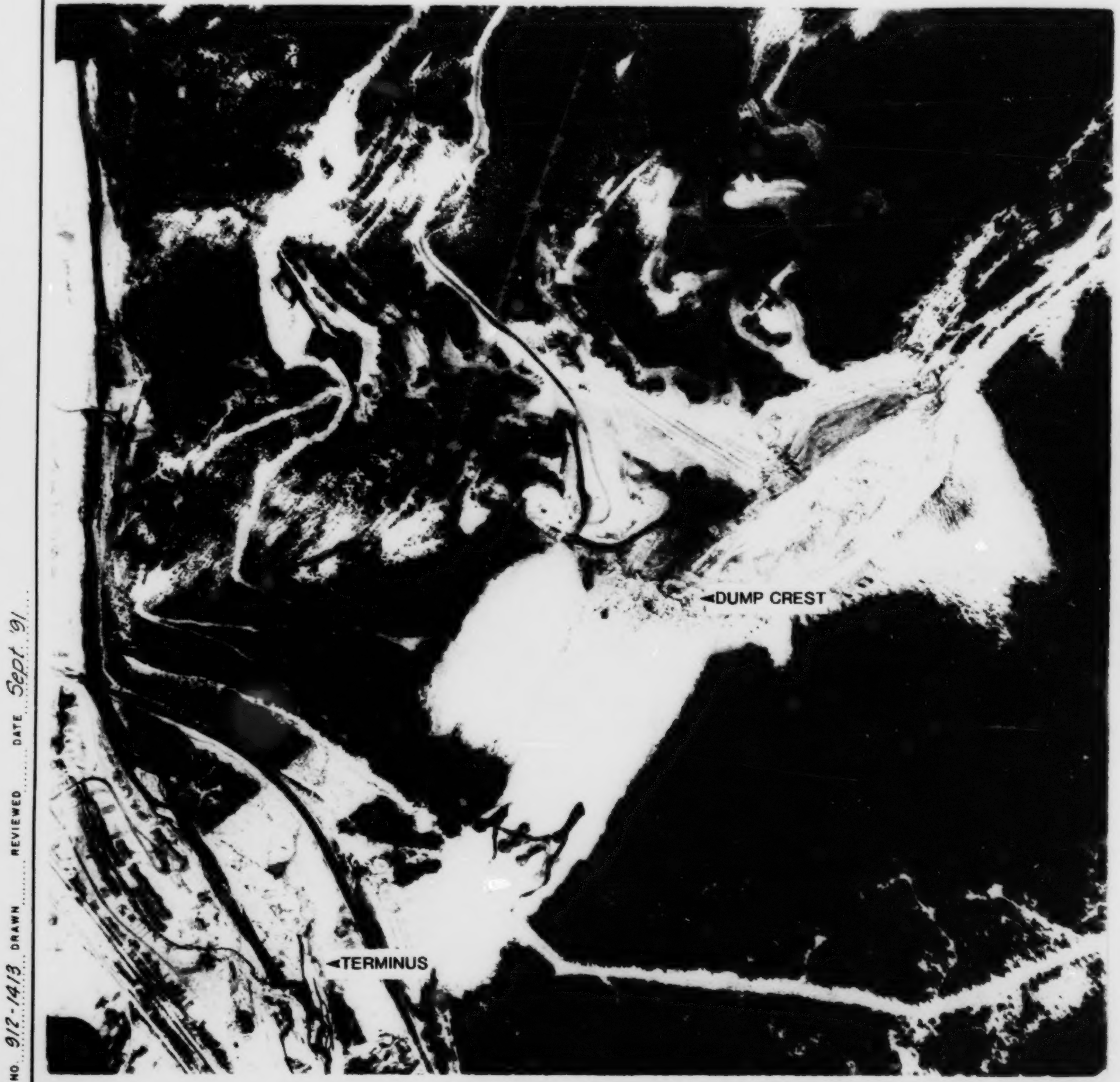

3360
SPARWOOD
NATAL
3700
3600
3500
3400
2700
HYDRO LINES
DISSIPATION MOUNDS
E
4400
DEBRIS AREA
TEST PIT 1
TEST PIT 2
TEST PIT
1400
1700
D
C
B
A
SIGHTING STATION
UNSTABLE AREA
TARGET
LOCATION OF PIT
FAILURE ARC
0 100 200 300 400 500 ft.
Approx. Scale : 1 in. to 200 ft.

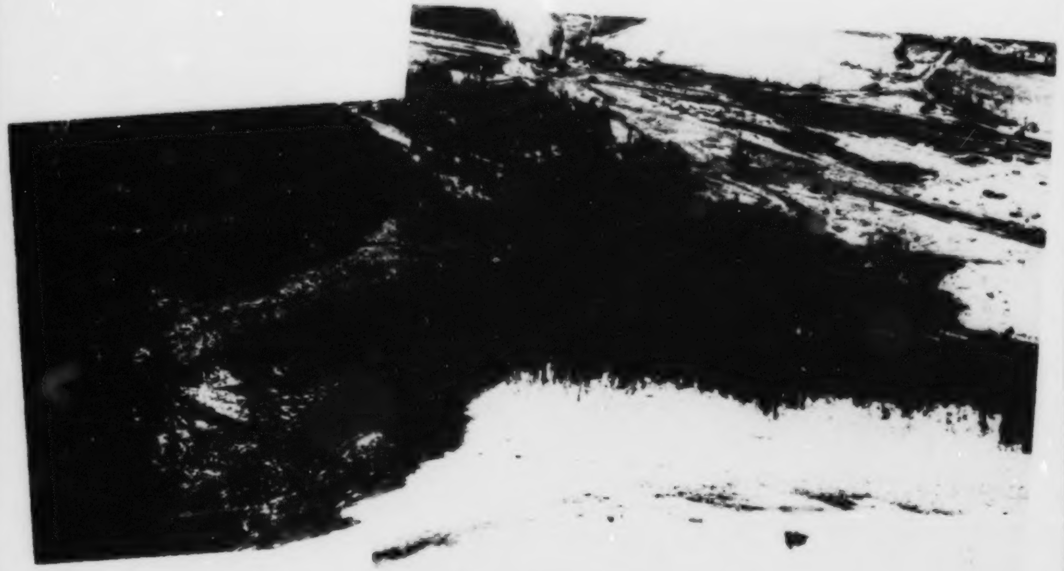
POST-FAILURE CONTOURS

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

BALMER A29-S #2 11/24/68

Figure 40 P

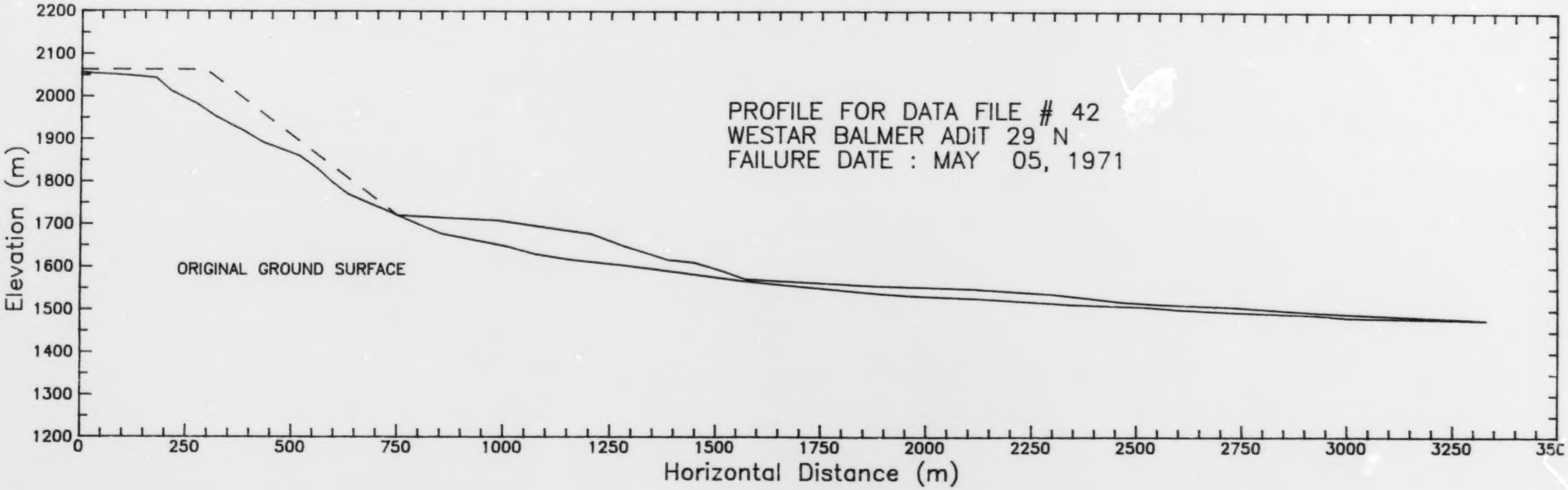

◄DUMP CREST
◄TERMINUS



SEVERAL DAYS POST FAILURE DURING RE-OPENING OF HIGHWAY

PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

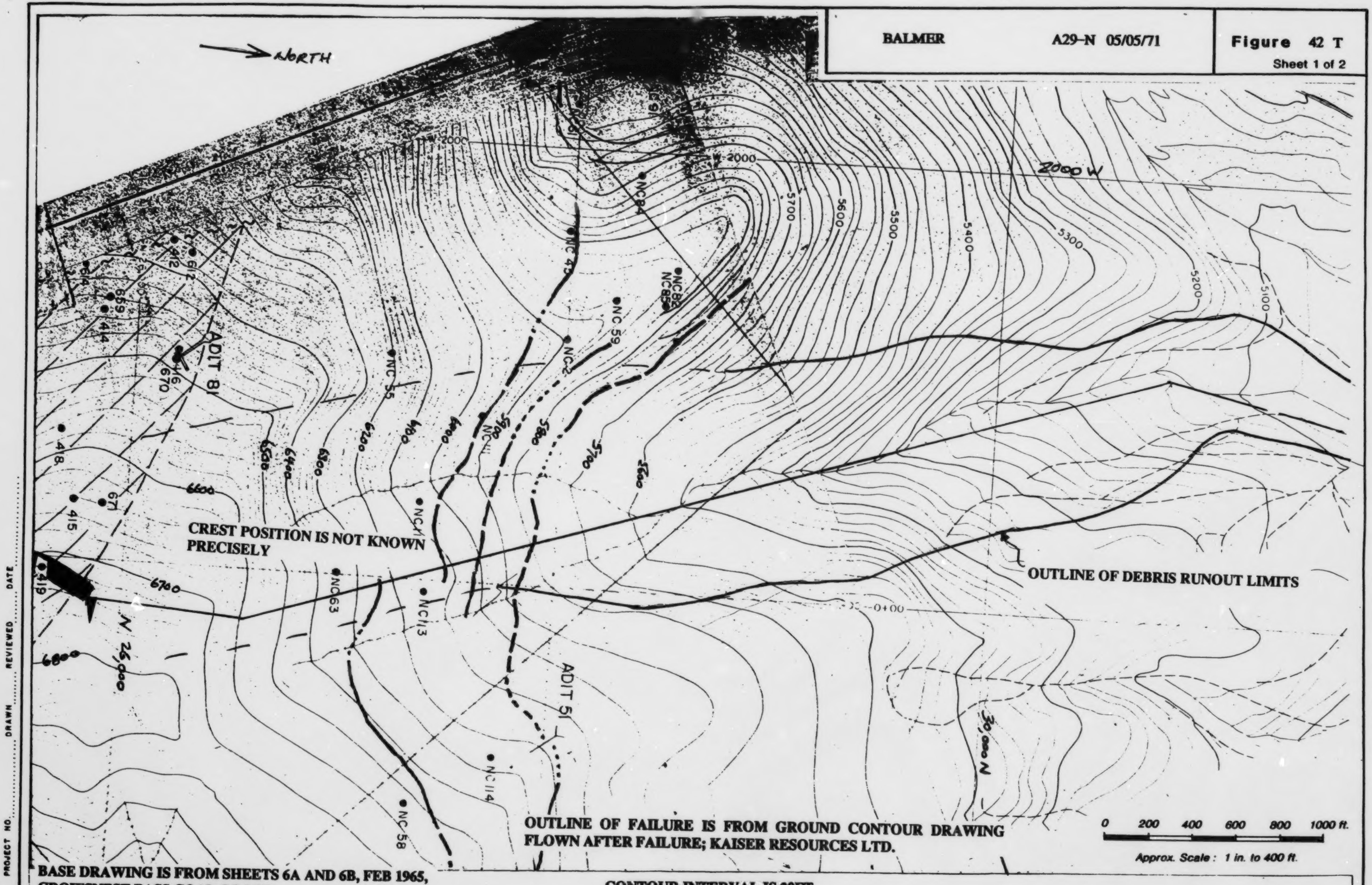
BALMER A29-N 05/05/71 **Figure** 42 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

BALMER A29-N 05/05/71

Figure 42 T
Sheet 1 of 2


NORTH
2000
2000
2000 W
5700
5600
5500
5400
5300
5200
5100
NC 84
NC 45
NC 82
NC 85
NC 59
NC 2
NC 55
NC 111
NC 11
NC 13
NC 63
NC 114
NC 58
ADIT 81
ADIT 51
412
612
614
659
414
416
670
418
415
671
419
6600
6700
6800
6500
6400
6300
6200
6100
6000
5900
5800
5700
5600
N 26,000
30,000 N
0+00
0 200 400 600 800 1000 ft.

CREST POSITION IS NOT KNOWN PRECISELY

OUTLINE OF DEBRIS RUNOUT LIMITS

OUTLINE OF FAILURE IS FROM GROUND CONTOUR DRAWING FLOWN AFTER FAILURE; KAISER RESOURCES LTD.

Approx. Scale : 1 in. to 400 ft.

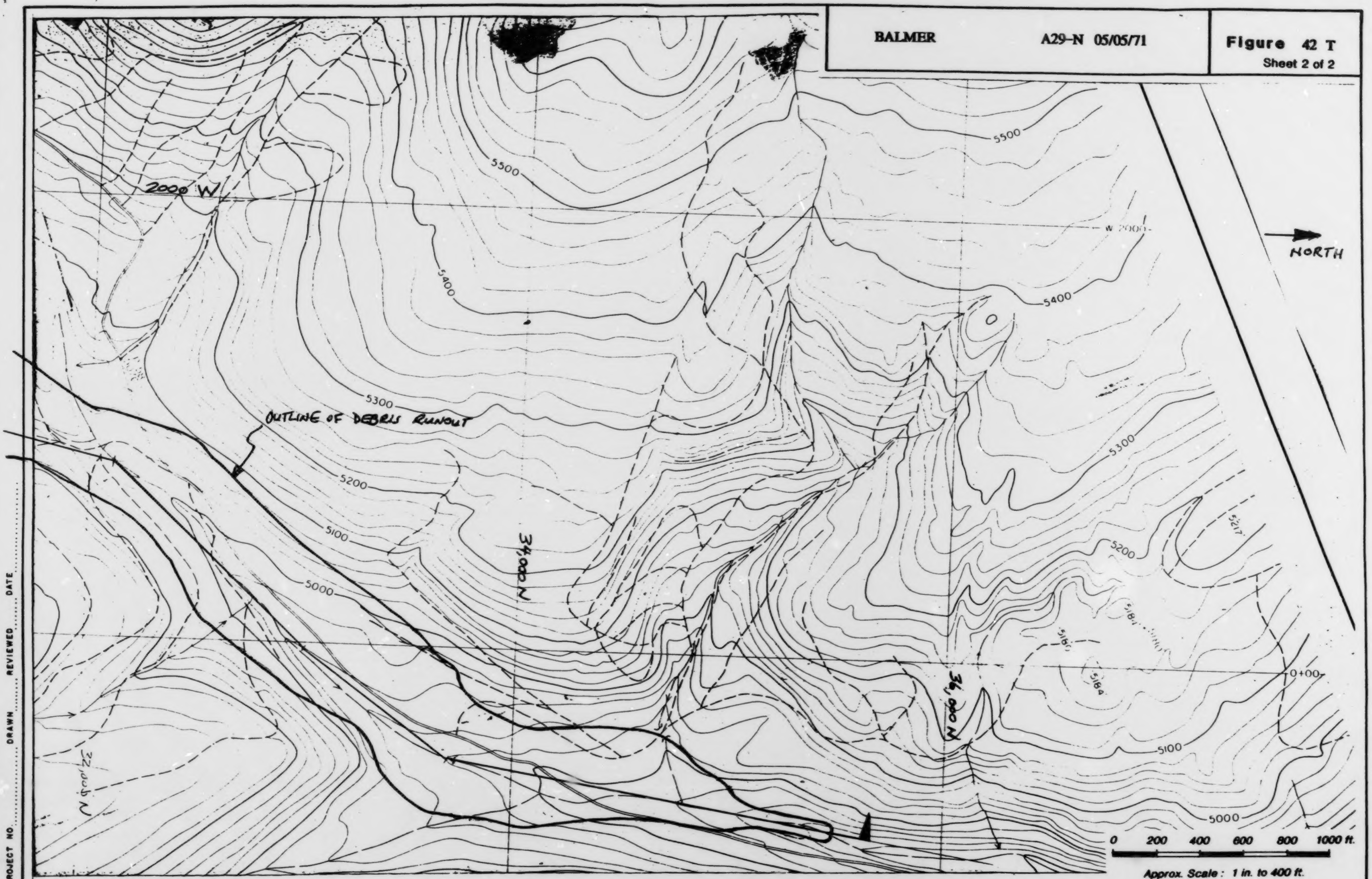
BASE DRAWING IS FROM SHEETS 6A AND 6B, FEB 1965, CROWSNEST PASS COAL CO LTD

CONTOUR INTERVAL IS 20FT

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

BALMER A29-N 05/05/71

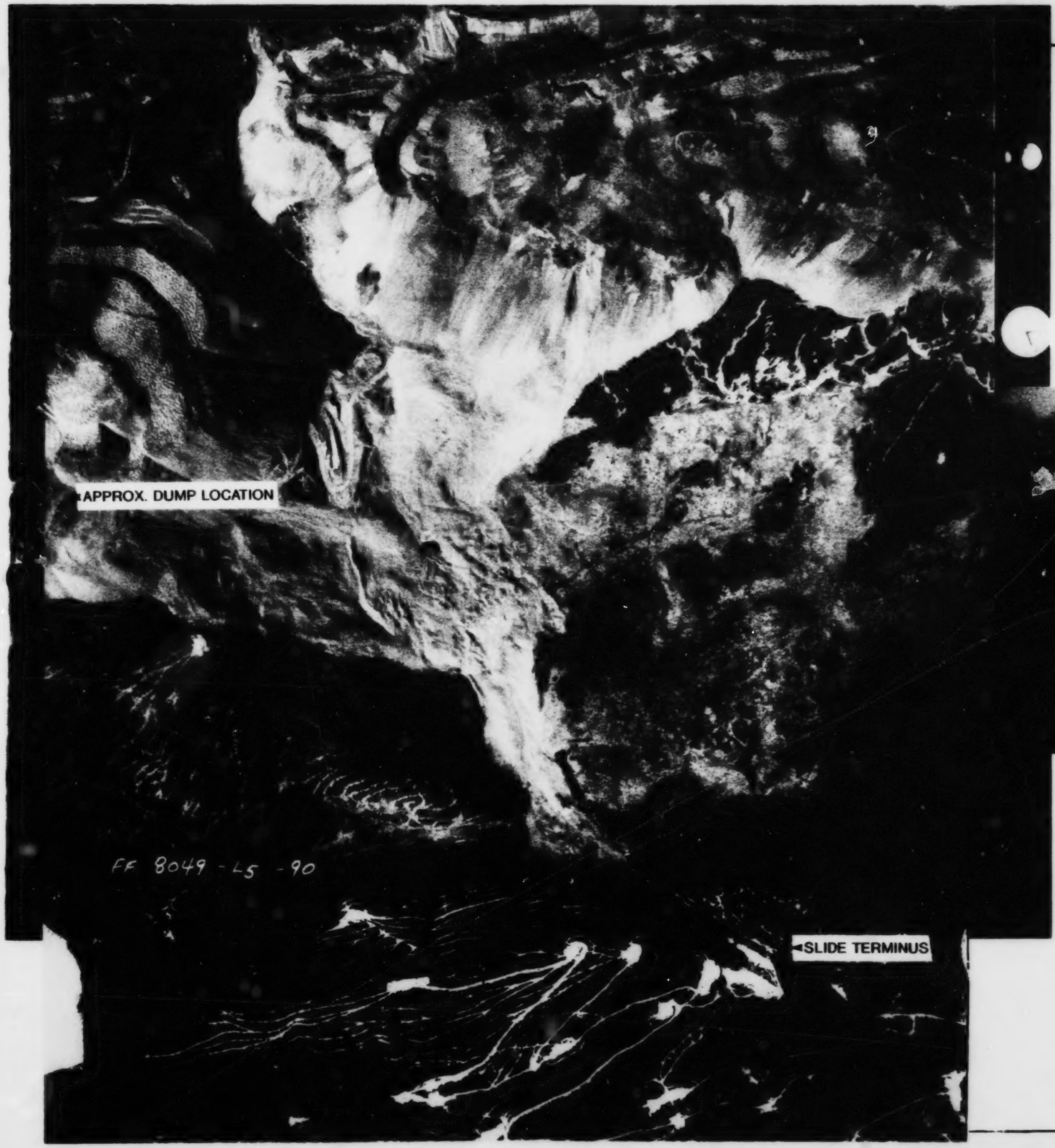
Figure 42 T
Sheet 2 of 2


2000 W
5500
5500
W 2000
NORTH
5400
5400
5300
OUTLINE OF DEBRIS RUNOUT
5300
5200
5200
5100
5000
34,000 N
5217
5184
5180
5184
0+00
36,000 N
5100
5000
32,000 N
0
200
400
600
800
1000 ft.

Approx. Scale : 1 in. to 400 ft.

PROJECT NO. ______ DRAWN ______ REVIEWED ______ DATE ______

BALMER A29-N 05/05/71	**Figure** 42 P


APPROX. DUMP LOCATION
FF 8049-L5-90
SLIDE TERMINUS

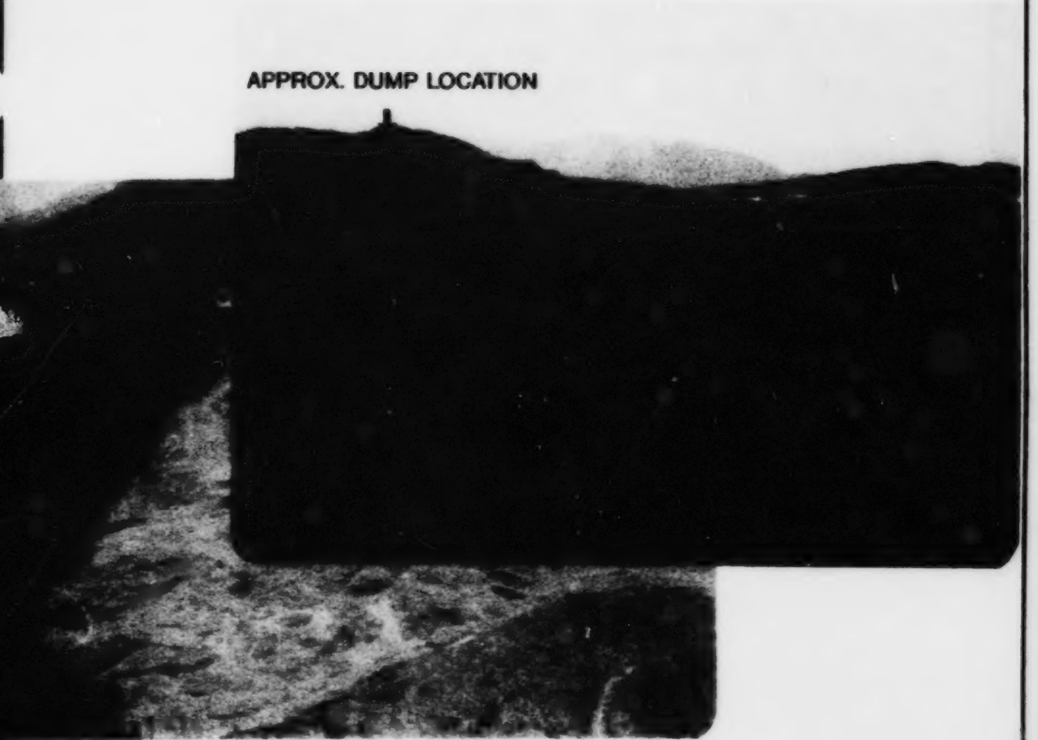
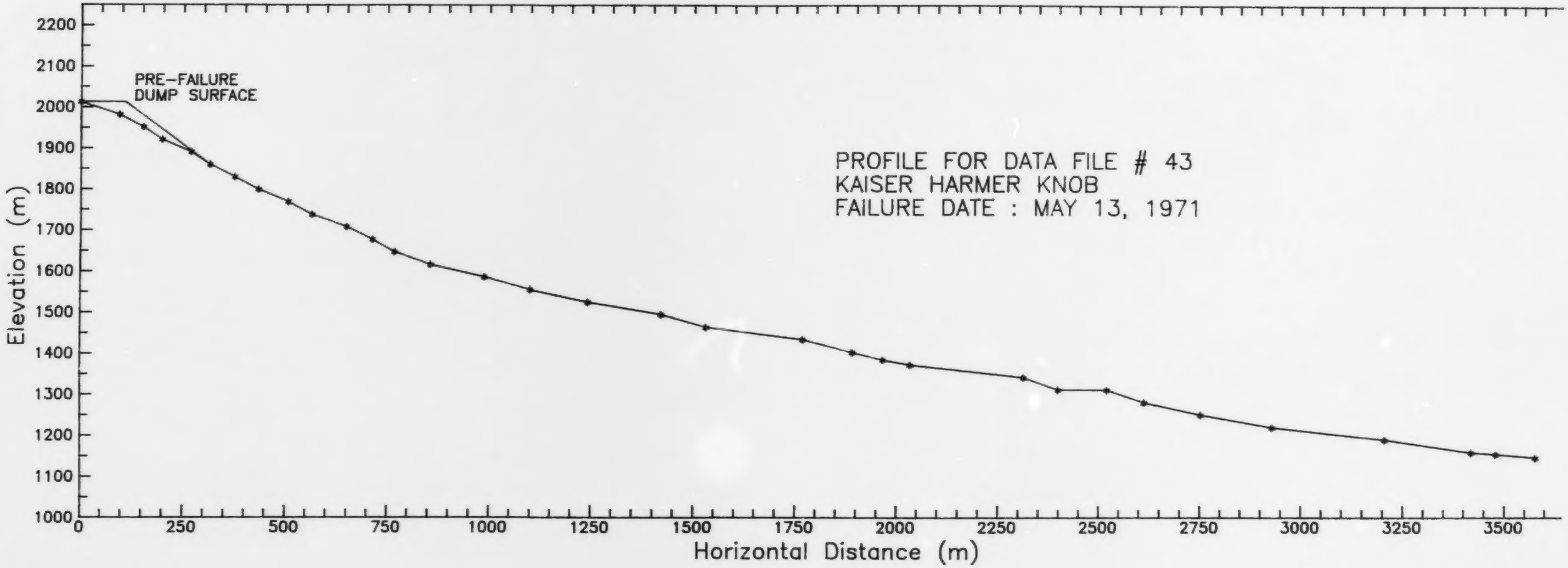

APPROX. DUMP LOCATION

Photo IV-1

Photograph looking south showing slide debris from Adit 29 North and Harmer No. 2 waste dumps in Harmer Creek.

BALMER H KNOB 05/13/71

Figure 43 S

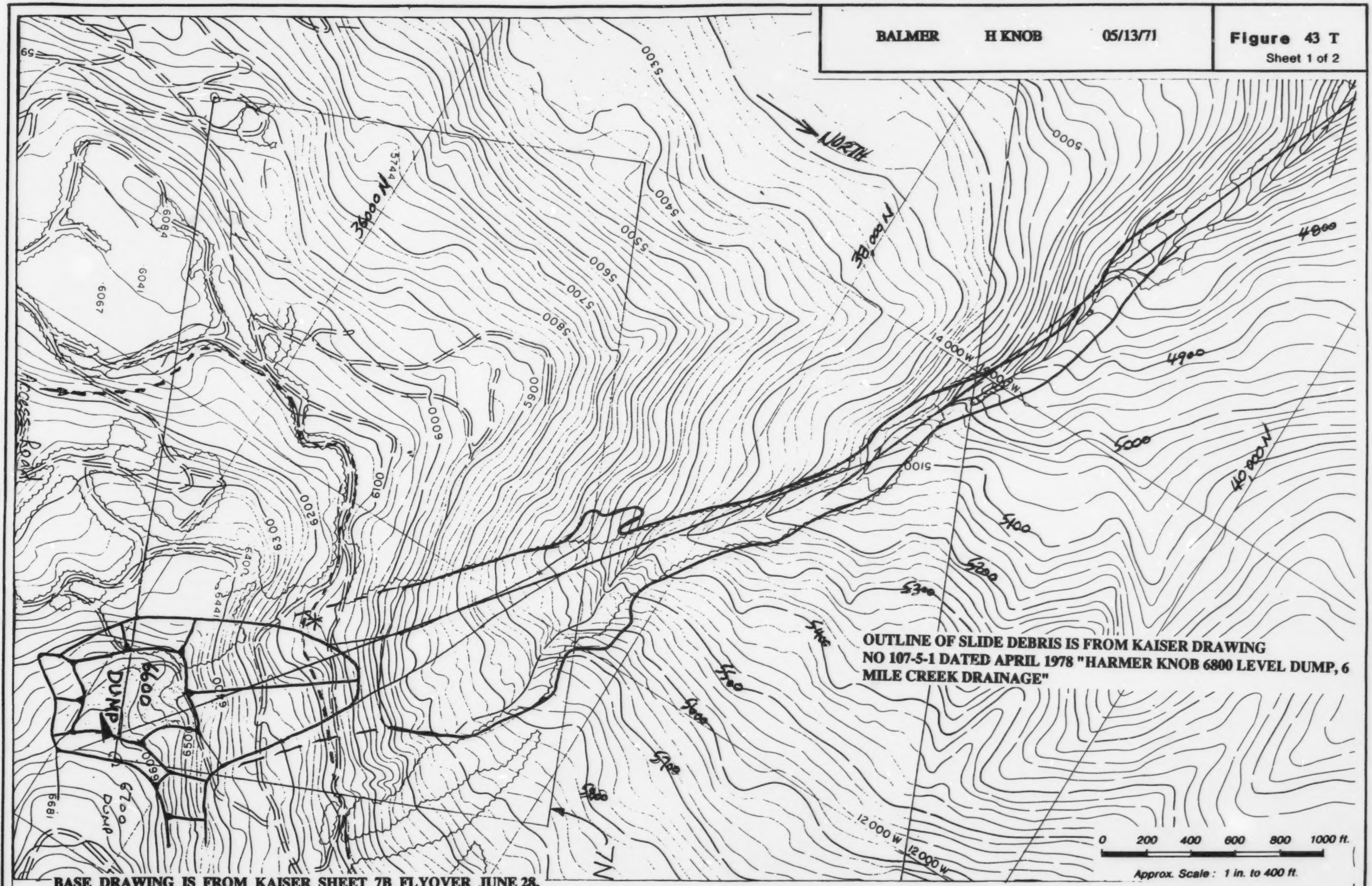


PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

BALMER H KNOB 05/13/71

Figure 43 T

Sheet 1 of 2


NORTH
36000 N
38,000 N
40,000 N
14,000 W
12,000 W
12,000 W
Access Road
DUMP
6600
6700 DUMP
4800
4900
5000
5100
5200
5300
5400
5500
5600
5700
5800
5900
6000
6100
6200
6300
6400
6441
6500
6600
5744
6084
6041
6067
6881
0 200 400 600 800 1000 ft.
Approx. Scale : 1 in. to 400 ft.

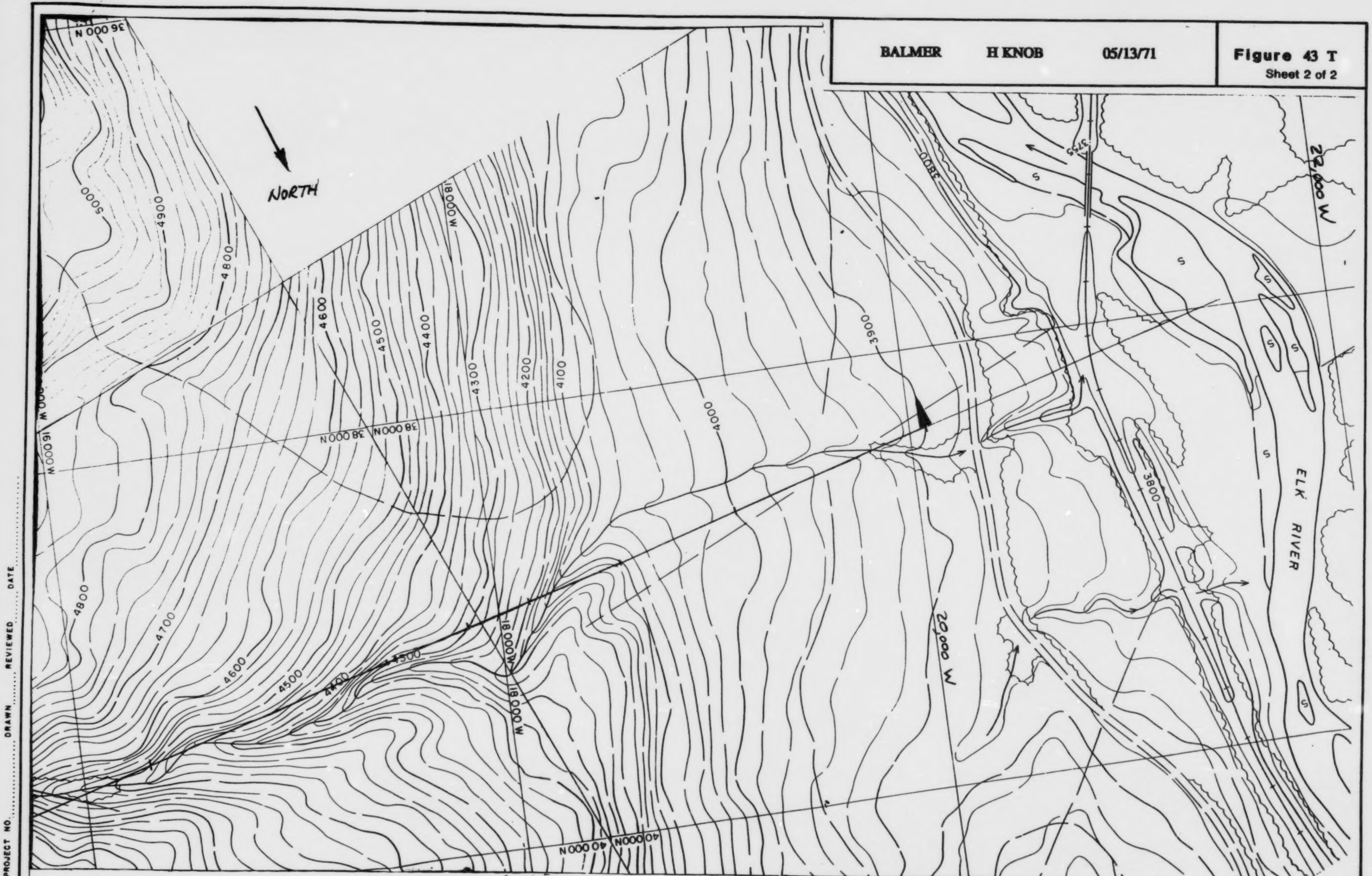
OUTLINE OF SLIDE DEBRIS IS FROM KAISER DRAWING NO 107-5-1 DATED APRIL 1978 "HARMER KNOB 6800 LEVEL DUMP, 6 MILE CREEK DRAINAGE"

BASE DRAWING IS FROM KAISER SHEET 7B FLYOVER JUNE 28, 1978 (POST FAILURE)

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

BALMER **H KNOB** **05/13/71**

Figure 43 T
Sheet 2 of 2

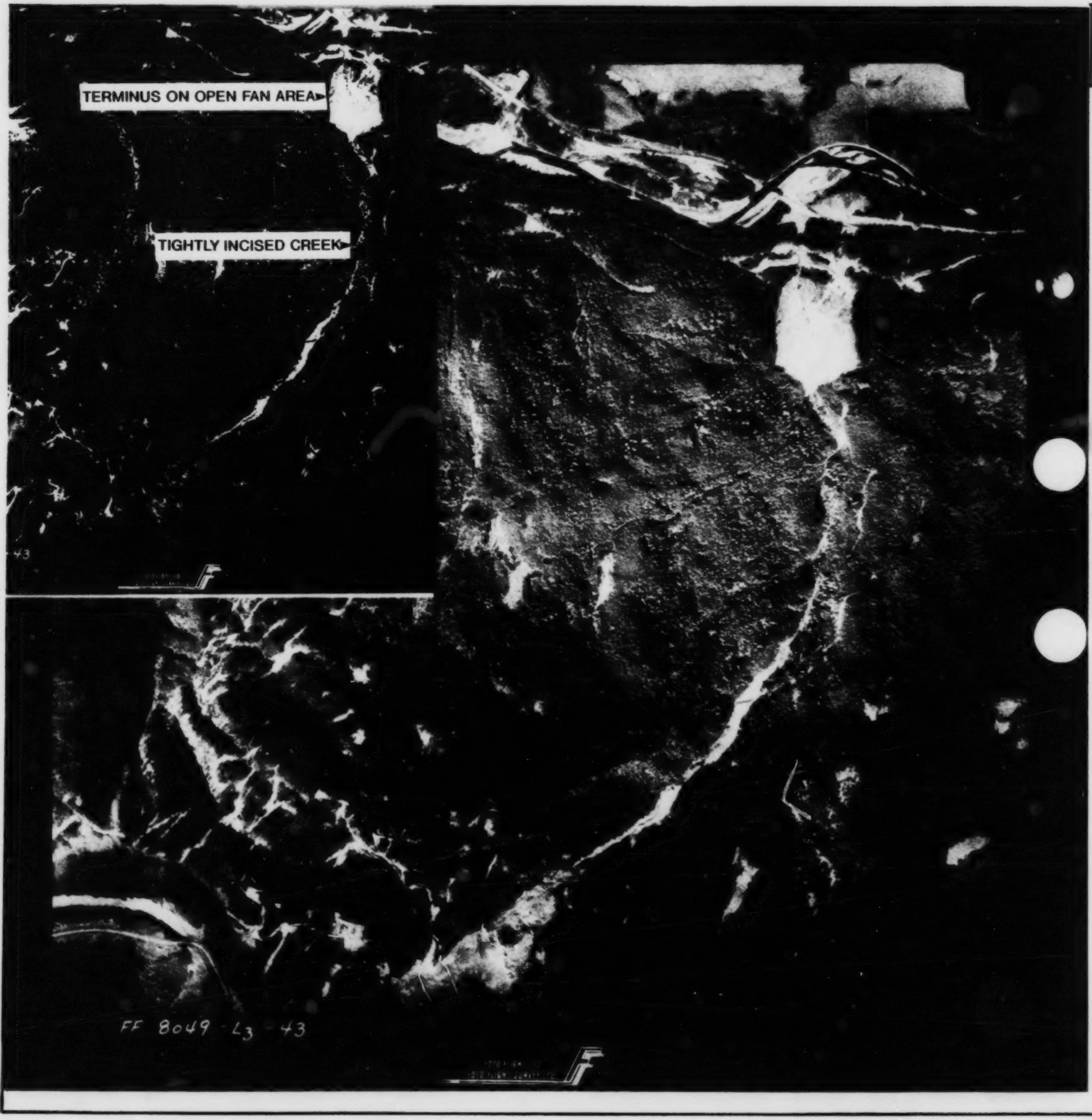

NORTH
36 000 N
38 000 N
40 000 N
16 000 W
18 000 W
20,000 W
22,000 W
5000
4900
4800
4700
4600
4500
4400
4300
4200
4100
4000
3900
3800
3755
ELK RIVER
S

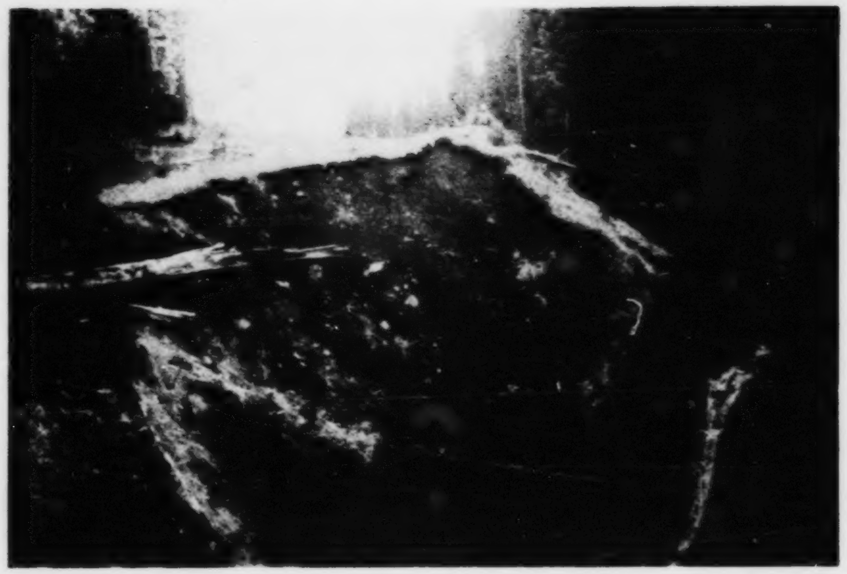
SCALE IS 1 INCH TO 400 FT

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

BALMER H KNOB 05/13/71

Figure 43 P

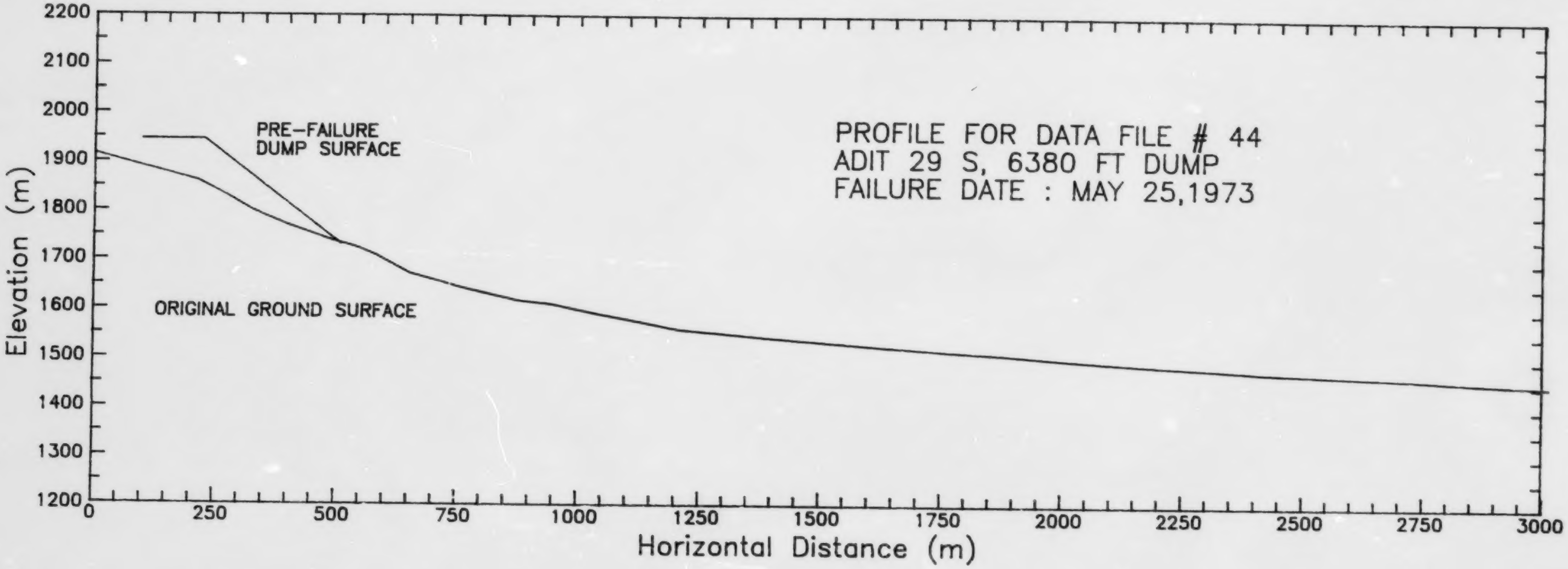

TERMINUS ON OPEN FAN AREA
TIGHTLY INCISED CREEK
43
FF 8049-L3-43



RUN OUT DEBRIS IN SIX MILE CREEK

PROJECT NO. DRAWN REVIEWED DATE

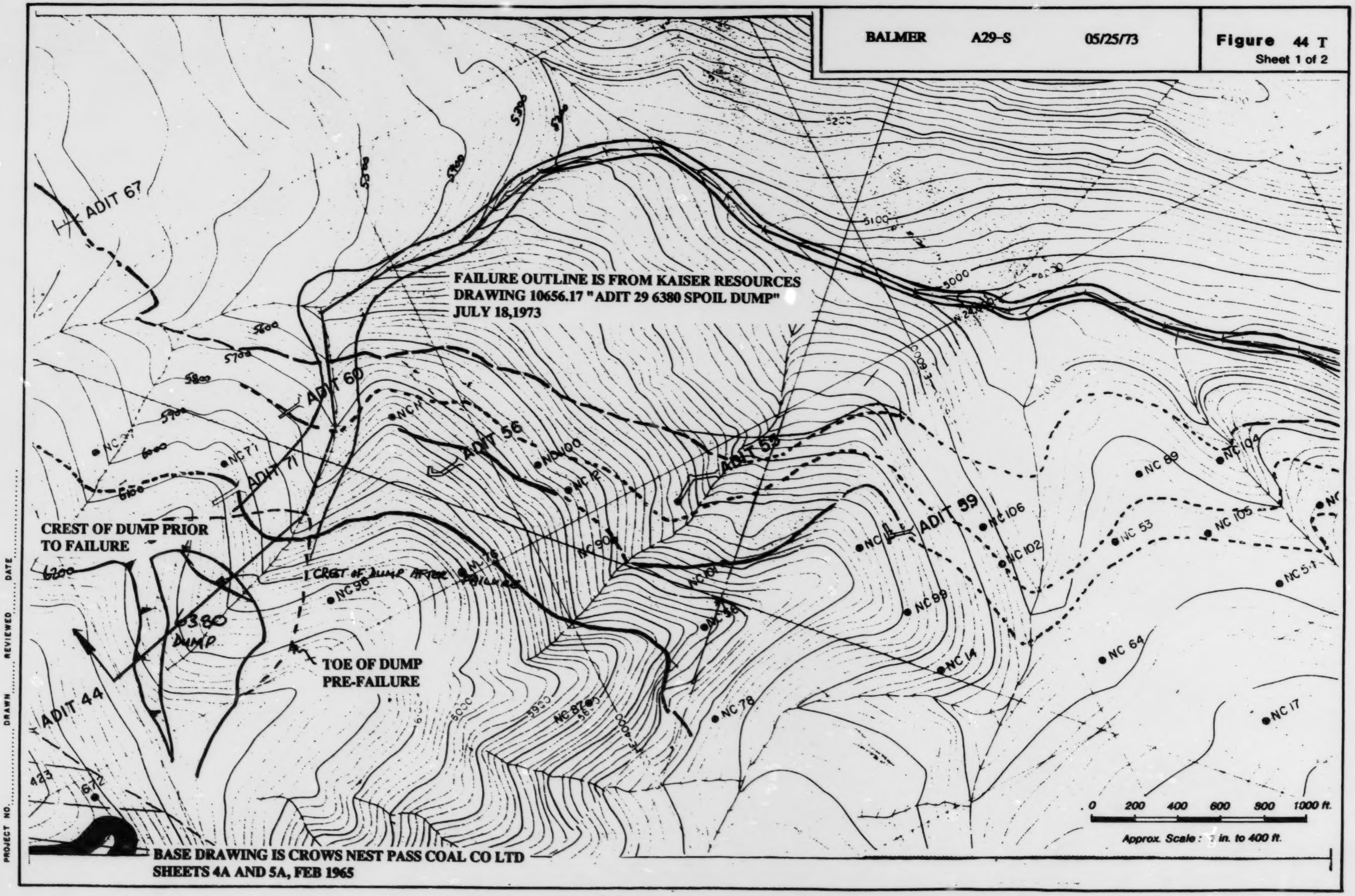
BALMER	**A29-S**	**05/25/73**	**Figure 44 S**



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

BALMER **A29-S** **05/25/73**

Figure 44 T
Sheet 1 of 2



FAILURE OUTLINE IS FROM KAISER RESOURCES DRAWING 10656.17 "ADIT 29 6380 SPOIL DUMP" JULY 18,1973

BASE DRAWING IS CROWS NEST PASS COAL CO LTD SHEETS 4A AND 5A, FEB 1965

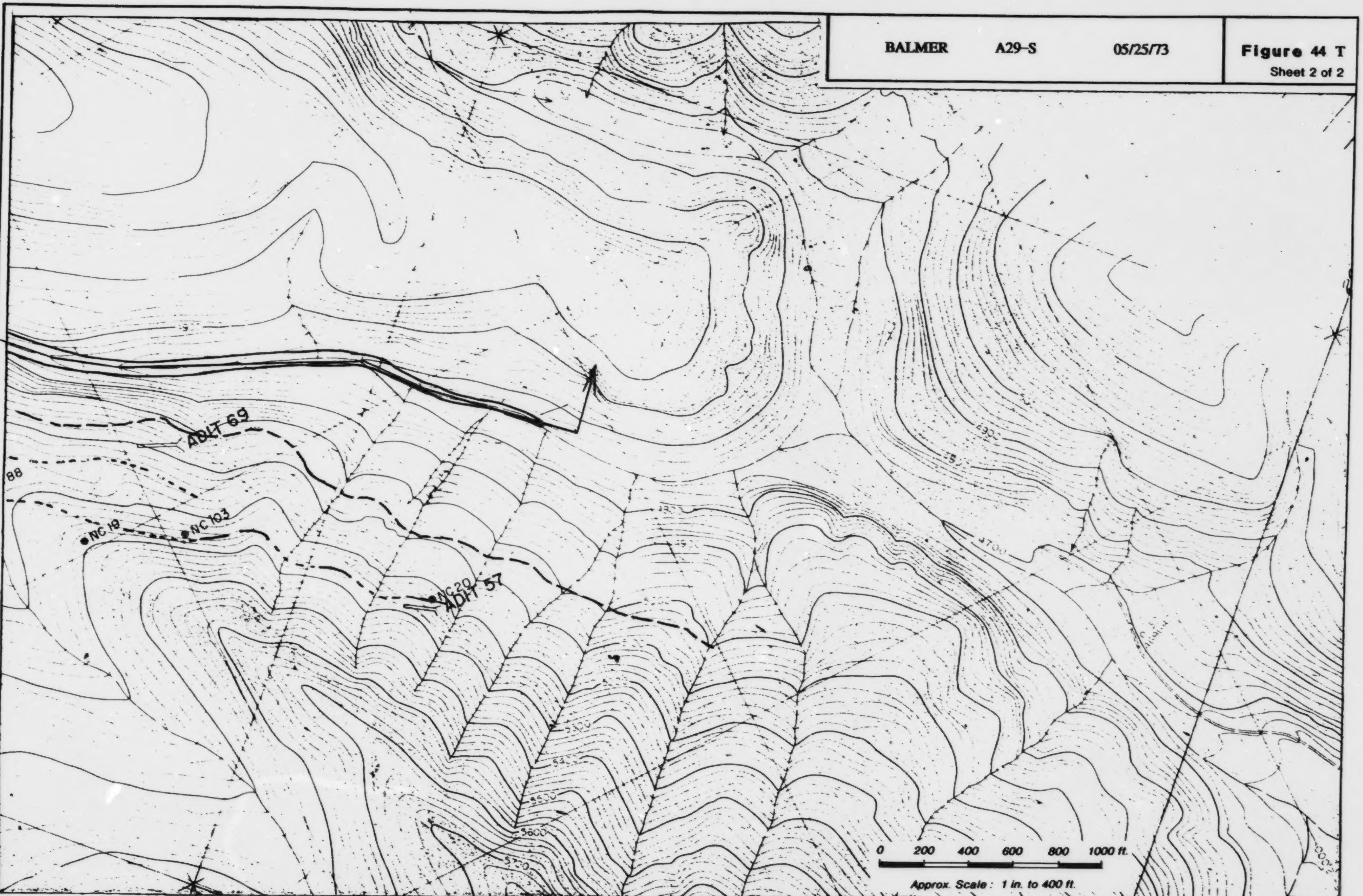
ADIT 67
ADIT 60
ADIT 56
ADIT 71
ADIT 53
ADIT 59
ADIT 44
CREST OF DUMP PRIOR TO FAILURE
CREST OF DUMP AFTER FAILURE
TOE OF DUMP PRE-FAILURE
6380 DUMP
5200
5100
5000
5300
5600
5700
5800
5900
6000
6100
6200
NC 71
NC 98
NC 100
NC 12
NC 90
NC 75
NC 101
NC 96
NC 87
NC 78
NC 99
NC 14
NC 106
NC 102
NC 89
NC 104
NC 53
NC 105
NC 64
NC 17
NC 51
423
672
0
200
400
600
800
1000 ft.
Approx. Scale : 1 in. to 400 ft.

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

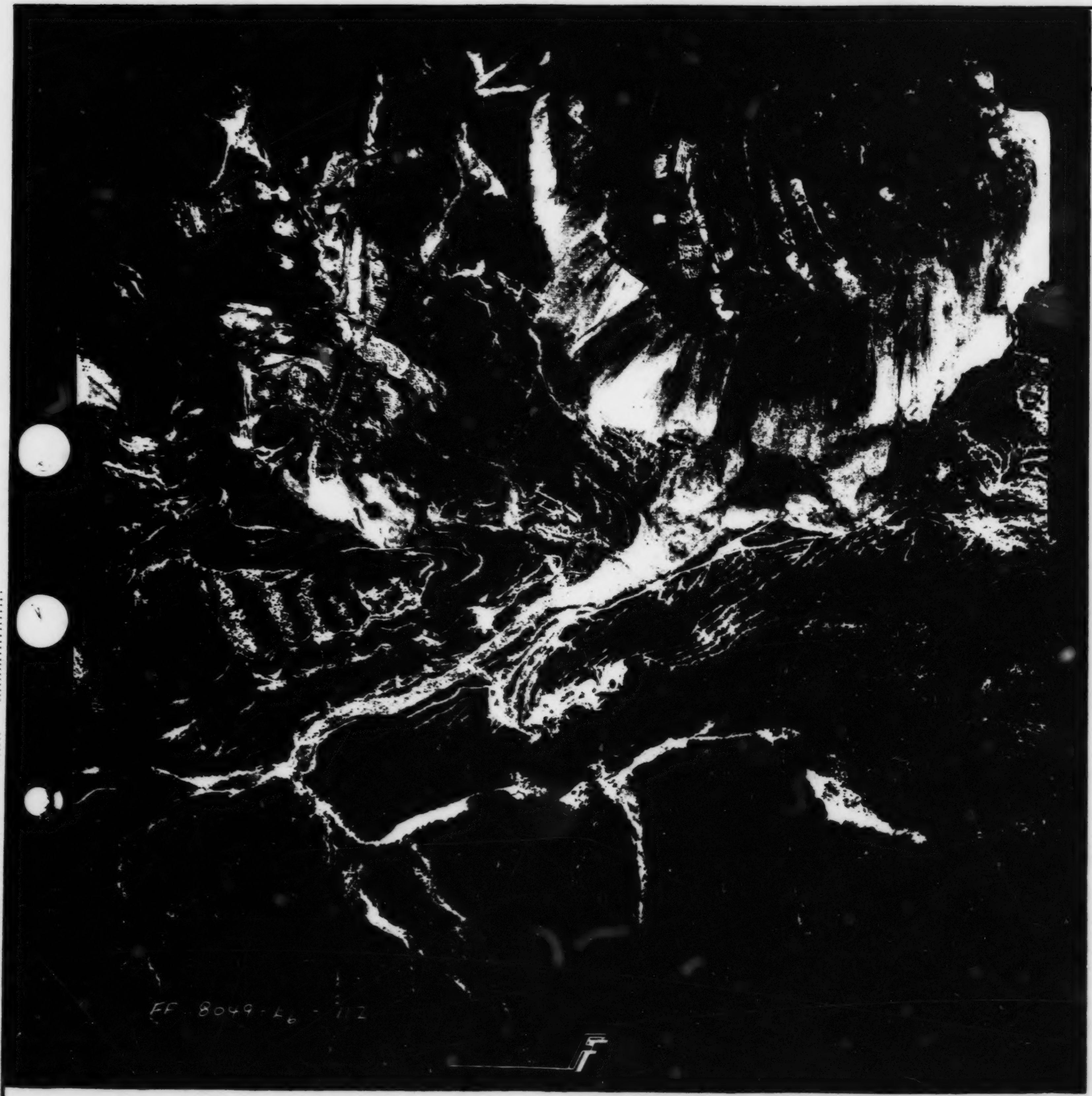
BALMER A29-S 05/25/73

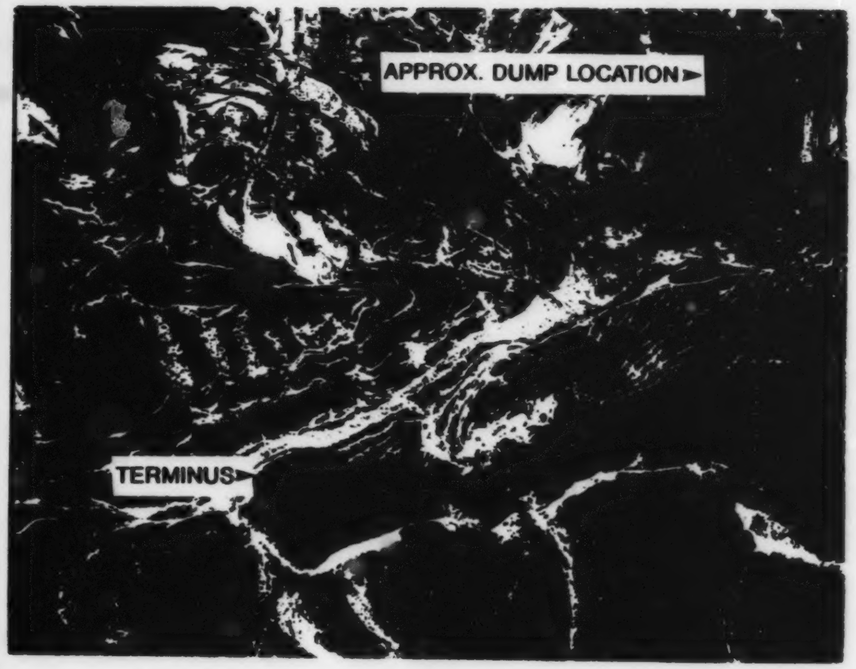
Figure 44 T
Sheet 2 of 2


ADIT 69
88
NC 19
NC 103
NC 20
ADIT 57
4900
4700
5300
5400
5500
5600
5700
0 200 400 600 800 1000 ft.
Approx. Scale : 1 in. to 400 ft.

BALMER A29-S 05/25/73

Figure 44 P

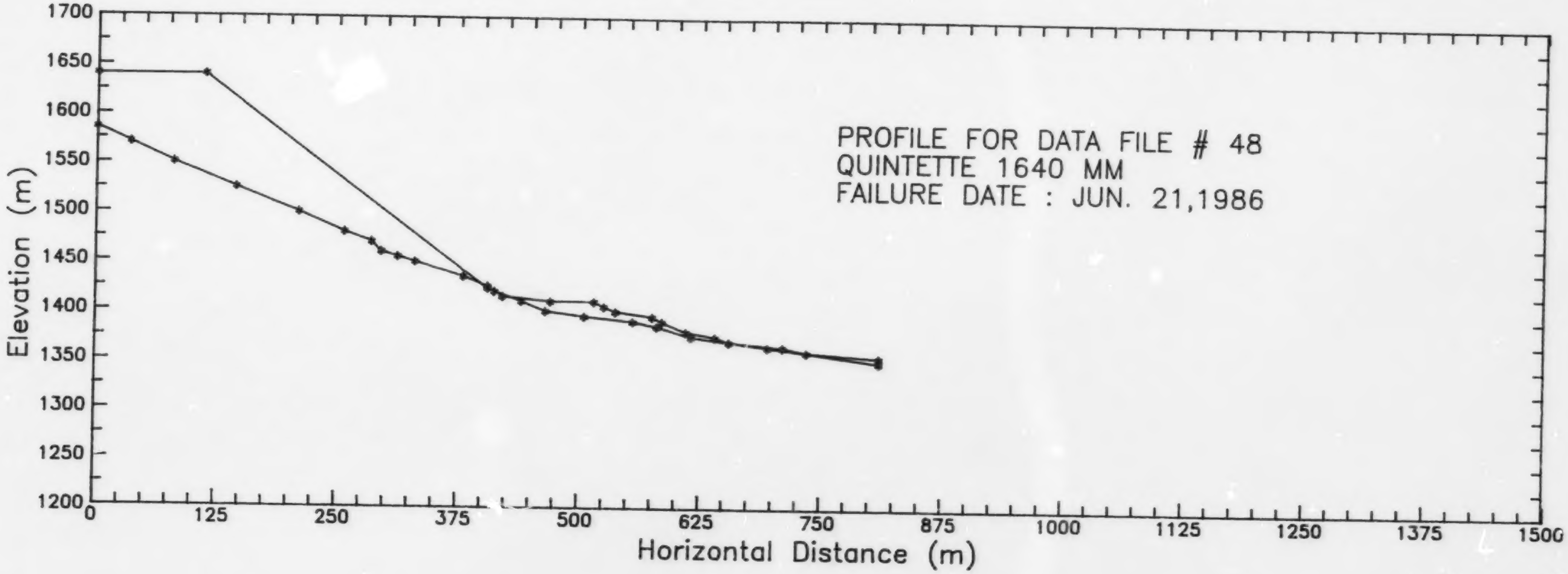

FF 8049-L6-112


APPROX. DUMP LOCATION►
TERMINUS►

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

QCL 1640 MM 06/21/86

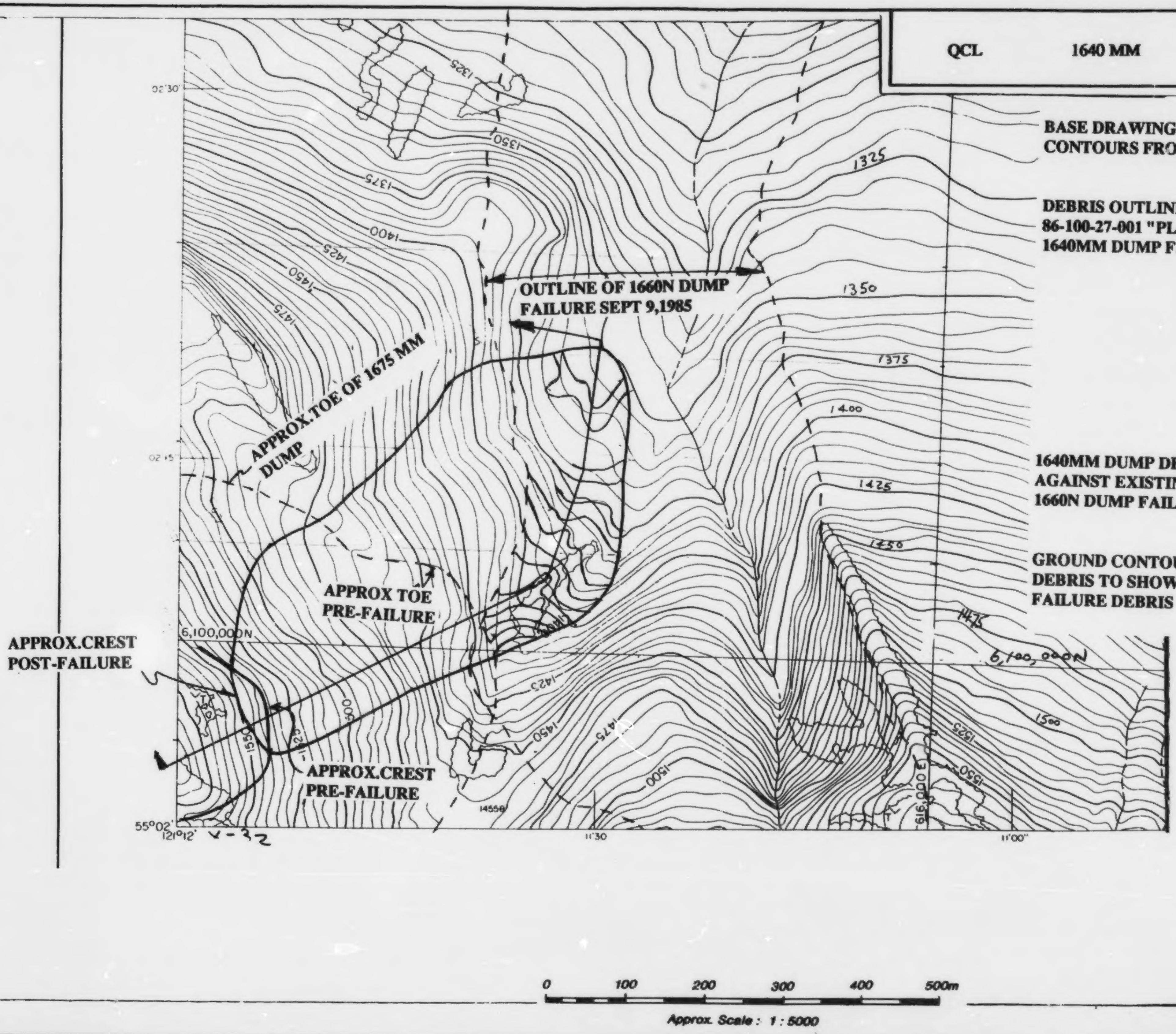
Figure 48 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

QCL 1640 MM 06/21/86

Figure 48 T



OUTLINE OF 1660N DUMP FAILURE SEPT 9,1985
APPROX.TOE OF 1675 MM DUMP
APPROX TOE PRE-FAILURE
APPROX.CREST POST-FAILURE
APPROX.CREST PRE-FAILURE
6,100,000N
6,100,000N
616,000 E
1325
1350
1375
1400
1425
1450
1475
1500
1525
1550
02'30"
02'15"
55°02'
121°12'
X-32
11'30
11'00"
14558
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

BASE DRAWING OF ORIGINAL GROUND CONTOURS FROM QCL SHT X-32

DEBRIS OUTLINE FROM QCL 86-100-27-001 "PLAN SHOWING 1640MM DUMP FAILURE JUNE 21,'86"

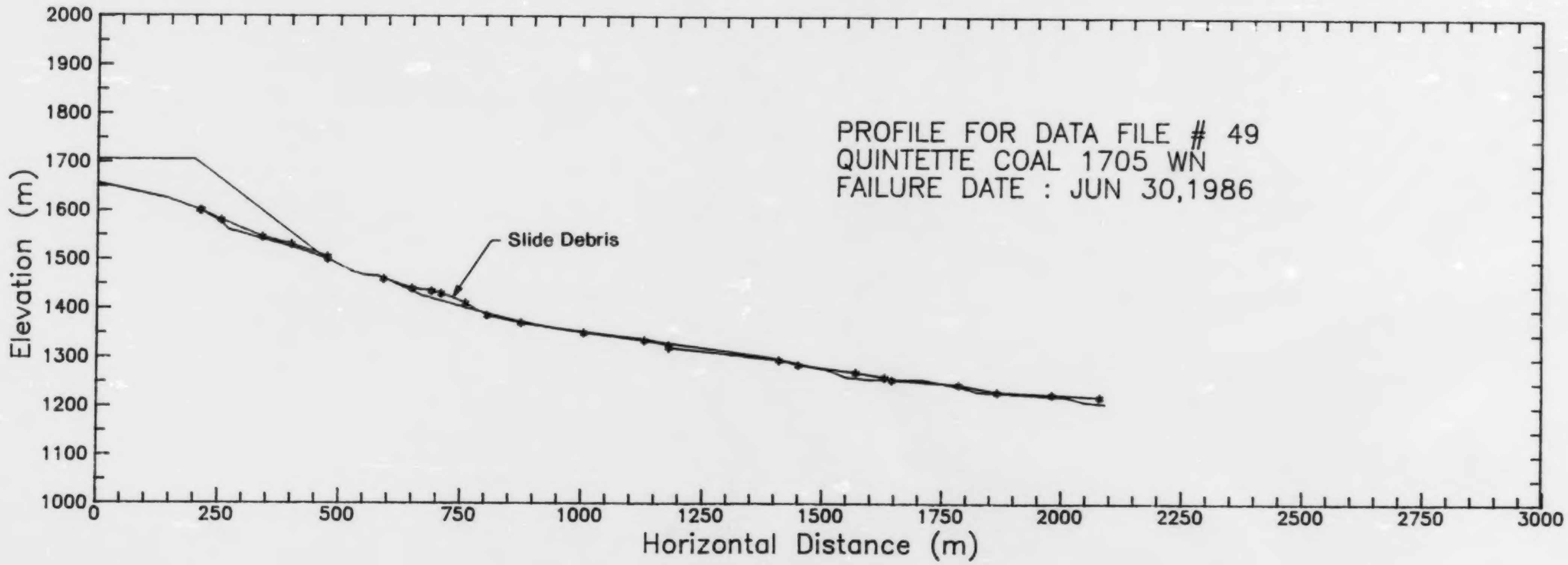
1640MM DUMP DEBRIS TERMINATED AGAINST EXISTING DEBRIS OF SEPT 9,'85 1660N DUMP FAILURE(EVENT 54)

GROUND CONTOURS REVISED BENEATH 1640 DEBRIS TO SHOW CONTOURS OF PRECEDING FAILURE DEBRIS

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

QCL 1705 WN 06/30/86

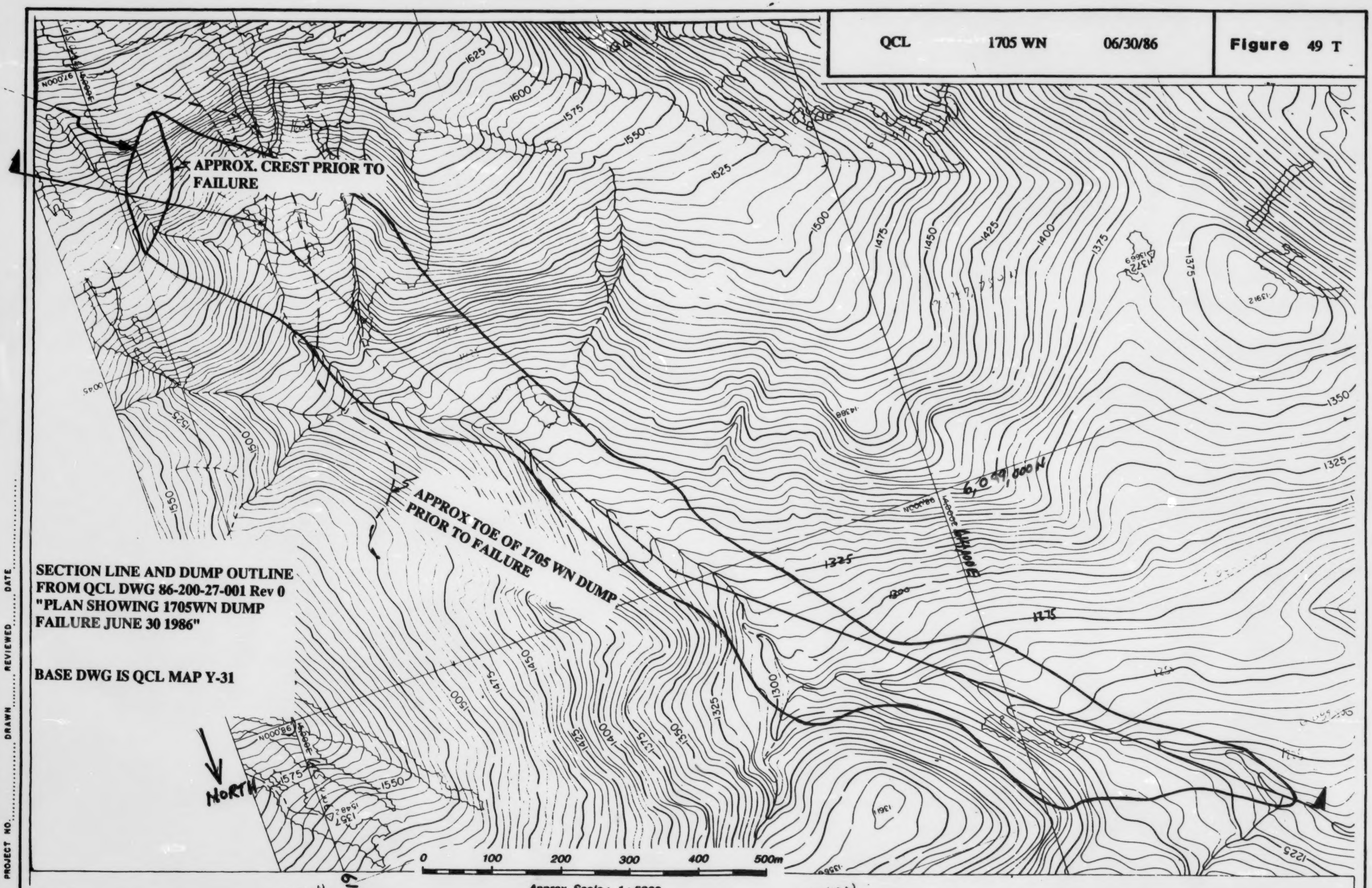
Figure 49 S



PROJECT NO. 912-1413 DRAWN ...... REVIEWED ...... DATE Sept. 91

QCL 1705 WN 06/30/86

Figure 49 T


APPROX. CREST PRIOR TO FAILURE
APPROX TOE OF 1705 WN DUMP PRIOR TO FAILURE
NORTH
6,099,000 N
1625
1600
1575
1550
1525
1500
1475
1450
1425
1400
1375
1350
1325
1300
1275
1225
0
100
200
300
400
500m

SECTION LINE AND DUMP OUTLINE FROM QCL DWG 86-200-27-001 Rev 0 "PLAN SHOWING 1705WN DUMP FAILURE JUNE 30 1986"

BASE DWG IS QCL MAP Y-31

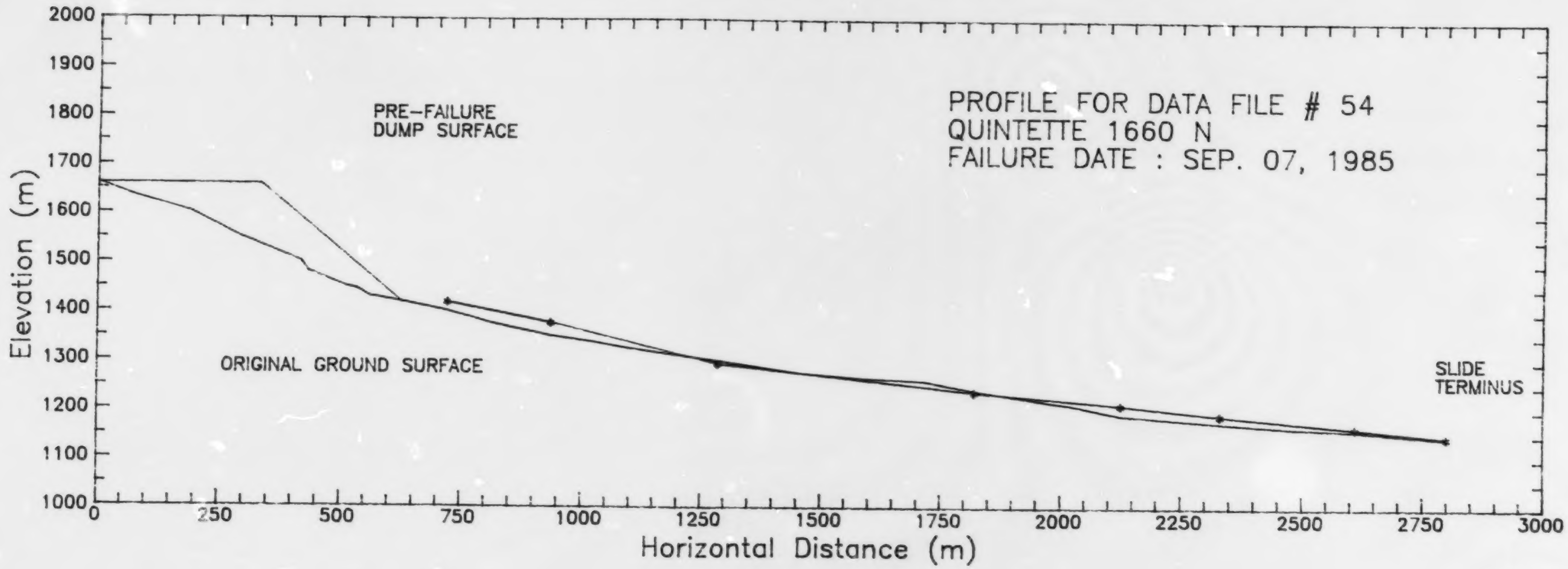
Approx. Scale : 1 : 5000

615,000 E

6,089,500 N

PROJECT NO. DRAWN REVIEWED DATE

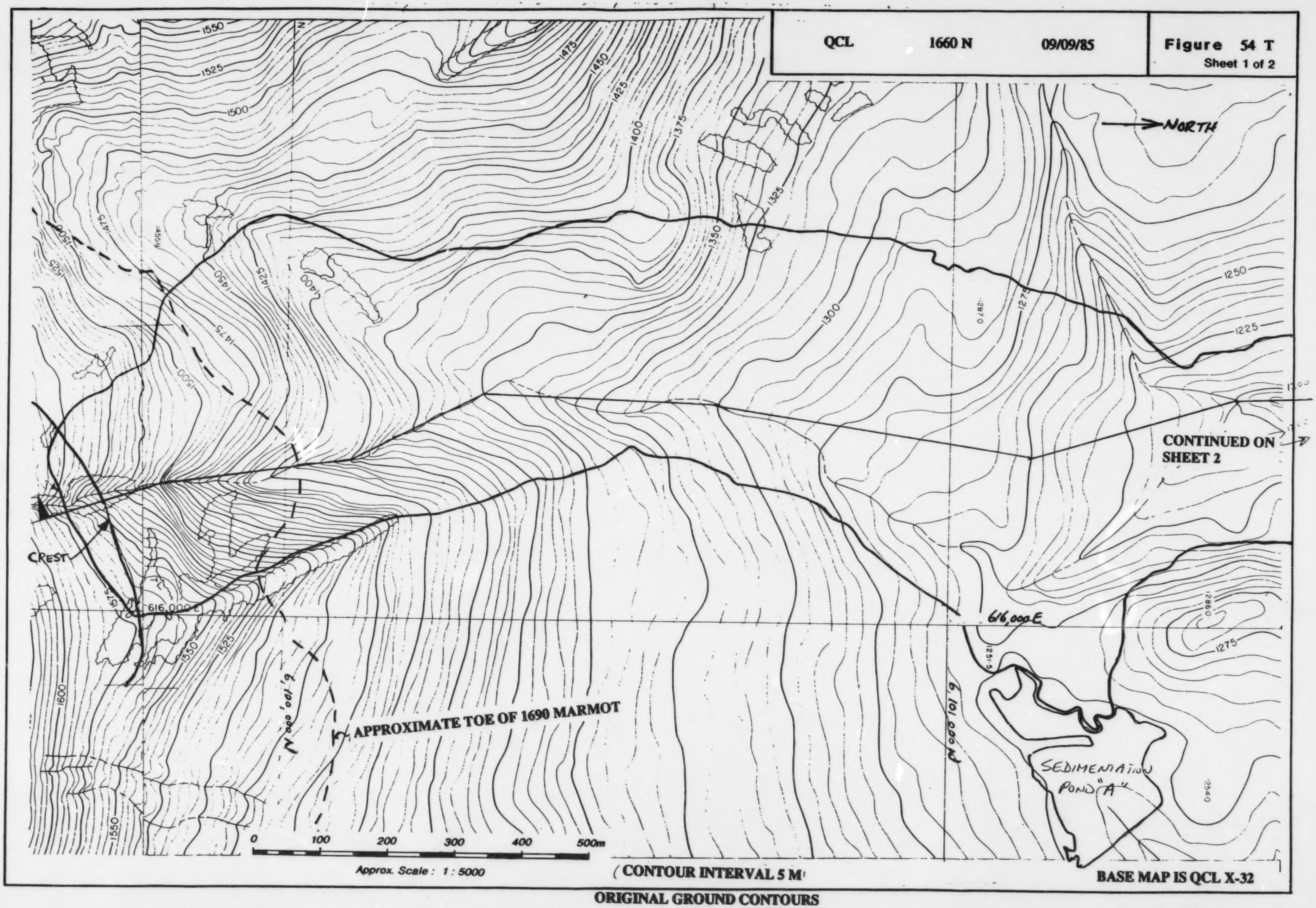
Figure 54 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

QCL 1660 N 09/09/85

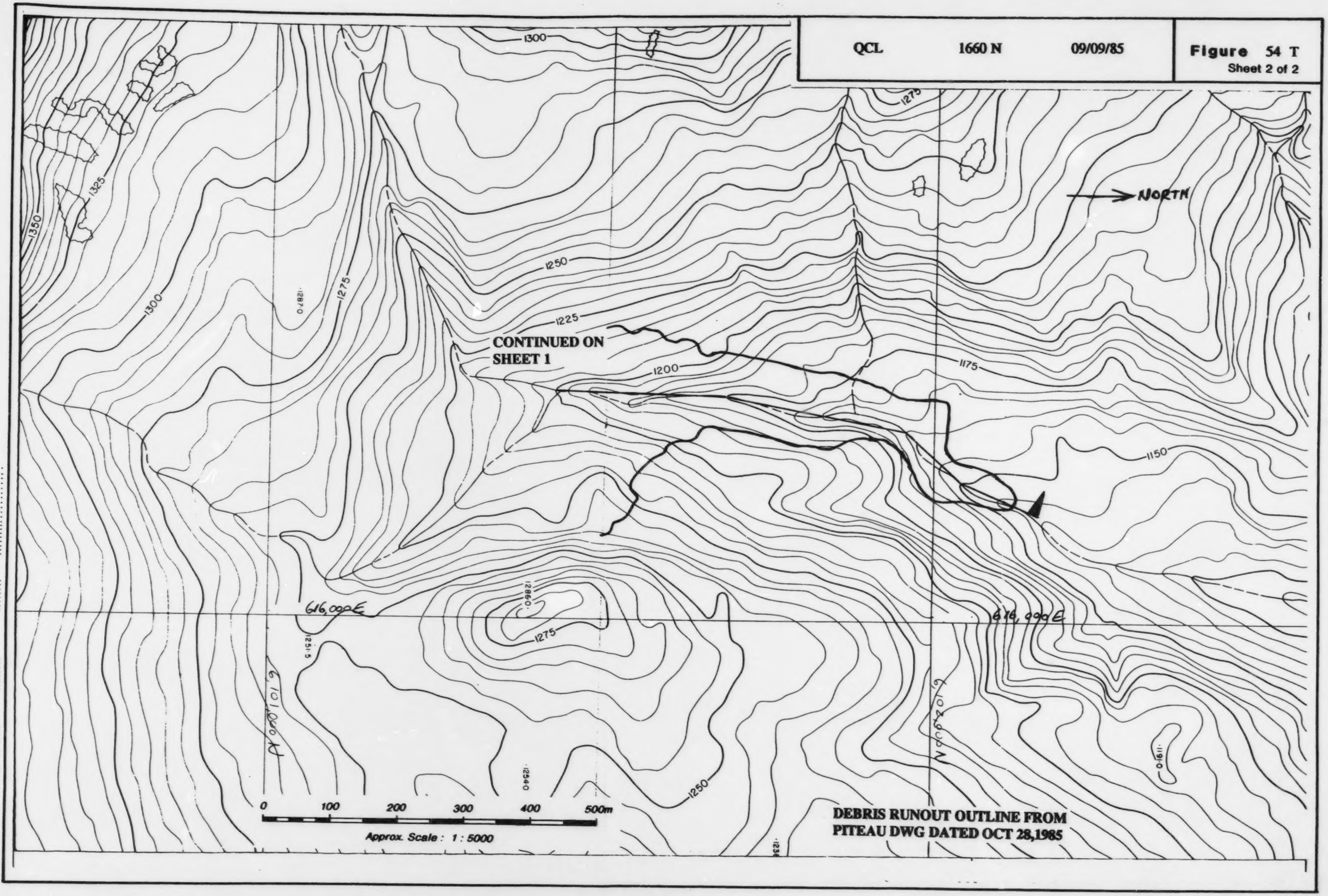
Figure 54 T
Sheet 1 of 2


NORTH
1550
1525
1500
1475
1450
1425
1400
1375
1350
1325
1300
1275
1250
1225
1287.0
1286.0
1254.0
1251.5
1600
1575
CREST
616,000 E
6,100,000 N
6,101,000 N
APPROXIMATE TOE OF 1690 MARMOT
CONTINUED ON SHEET 2
SEDIMENTATION POND "A"
0
100
200
300
400
500m
Approx. Scale : 1 : 5000
CONTOUR INTERVAL 5 M
BASE MAP IS QCL X-32

ORIGINAL GROUND CONTOURS

QCL **1660 N** **09/09/85**

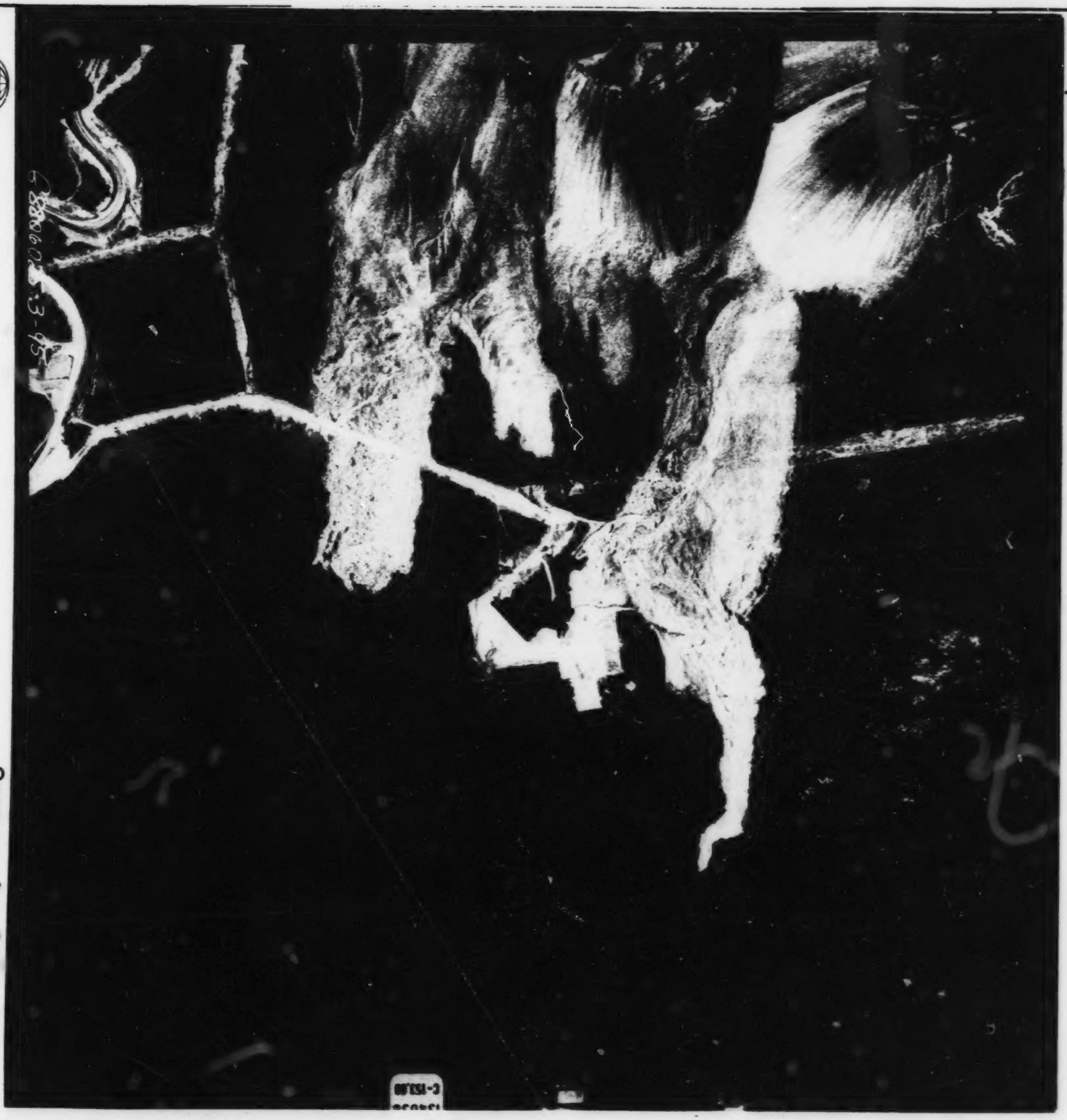
Figure 54 T
Sheet 2 of 2

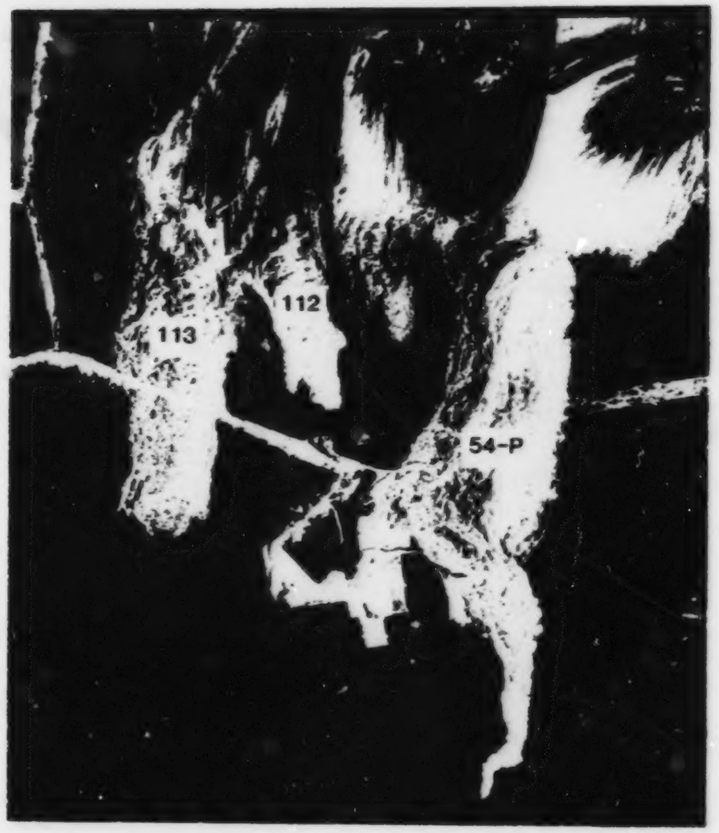

1300
1275
1325
1350
1300
1275
1287.0
1250
1225
1200
1175
1150
CONTINUED ON SHEET 1
NORTH
616,000E
618,000E
1286.0
1275
1251.5
6,101,000 N
6,102,000 N
1254.0
1250
1191.0
1234
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

DEBRIS RUNOUT OUTLINE FROM PITEAU DWG DATED OCT 28,1985

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

QCL 1660 N 09/09/85 **Figure 54 P**


6 2806 02-3-95
C-15230

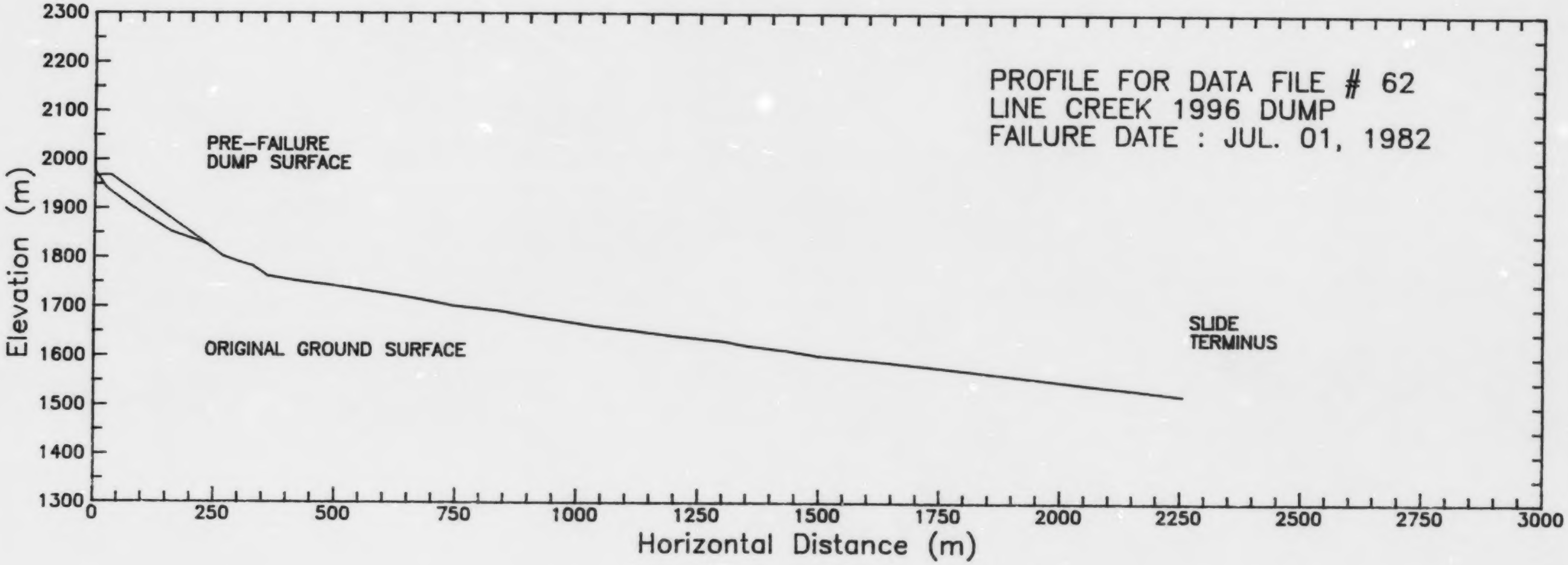


GEOGRAPHIC AIR SURVEY LTD.
17 AIRPORT ROAD, MUNICIPAL AIRPORT, EDMONTON, ALBERTA [illegible]

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

LINE CREEK 1966 W 07/01/82

Figure 62 S

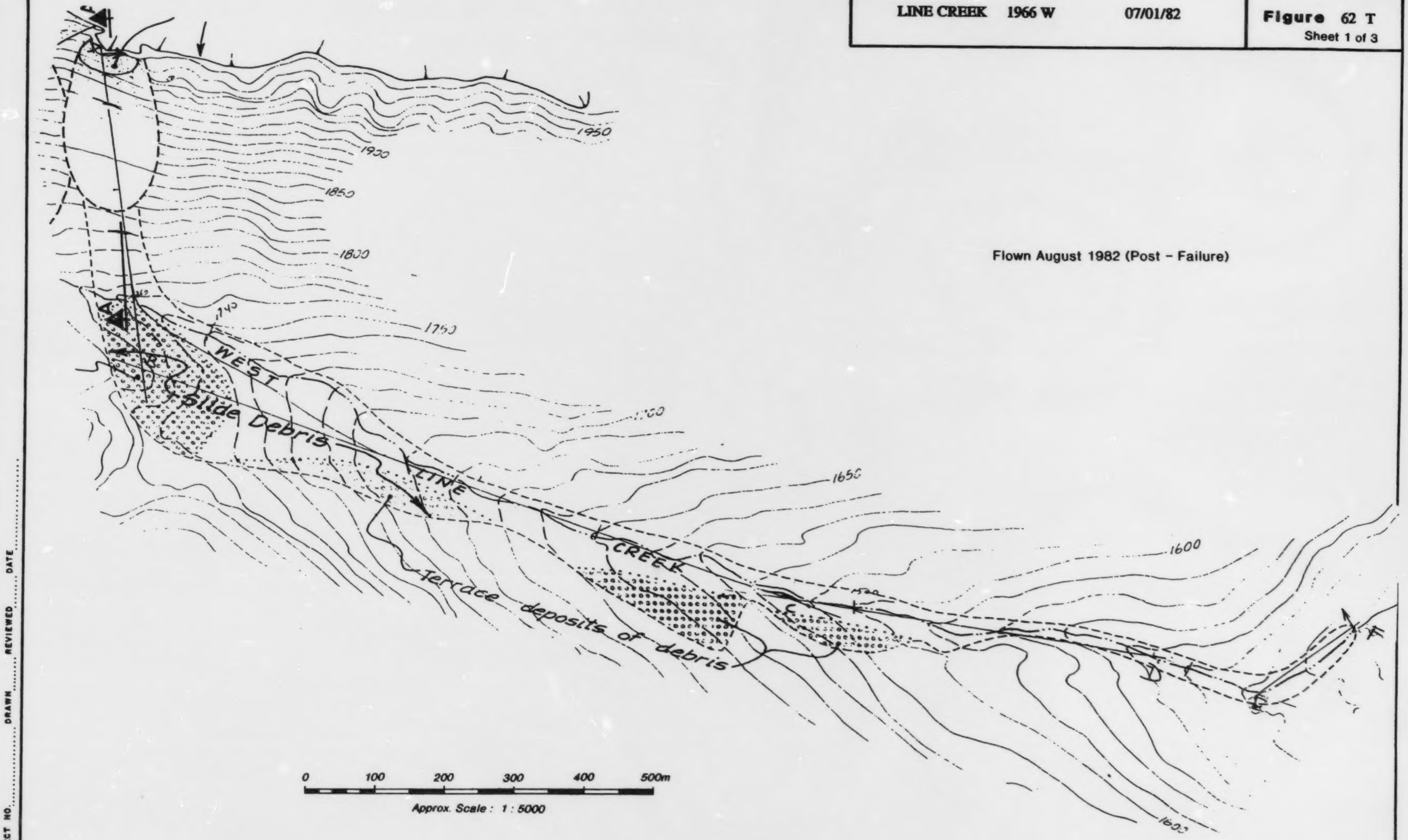


PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

LINE CREEK 1966 W 07/01/82

Figure 62 T
Sheet 1 of 3

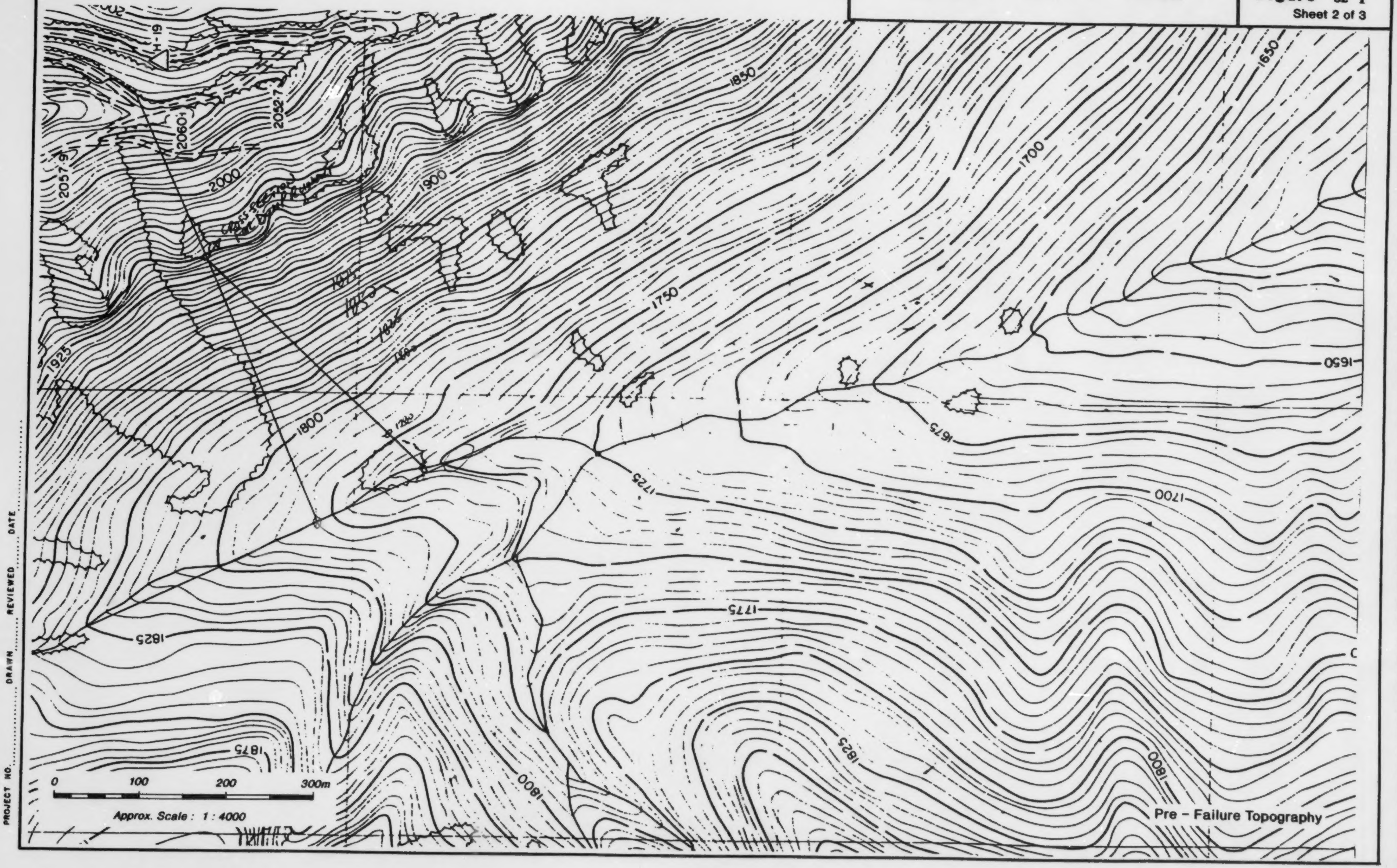
Flown August 1982 (Post - Failure)


1950
1900
1850
1800
1750
1740
1700
1650
1600
1500
A
B
C
D
E
F
WEST LINE CREEK
Slide Debris
Terrace deposits of debris
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

LINE CREEK 1966 W 07/01/82

Figure 62 T
Sheet 2 of 3


H-19
2057.9
2060.1
2052.7
2000
1900
1850
1750
1700
1650
1650
1925
1800
1675
1725
1700
1825
1775
1875
1800
1825
1800
Cross Section
0
100
200
300m

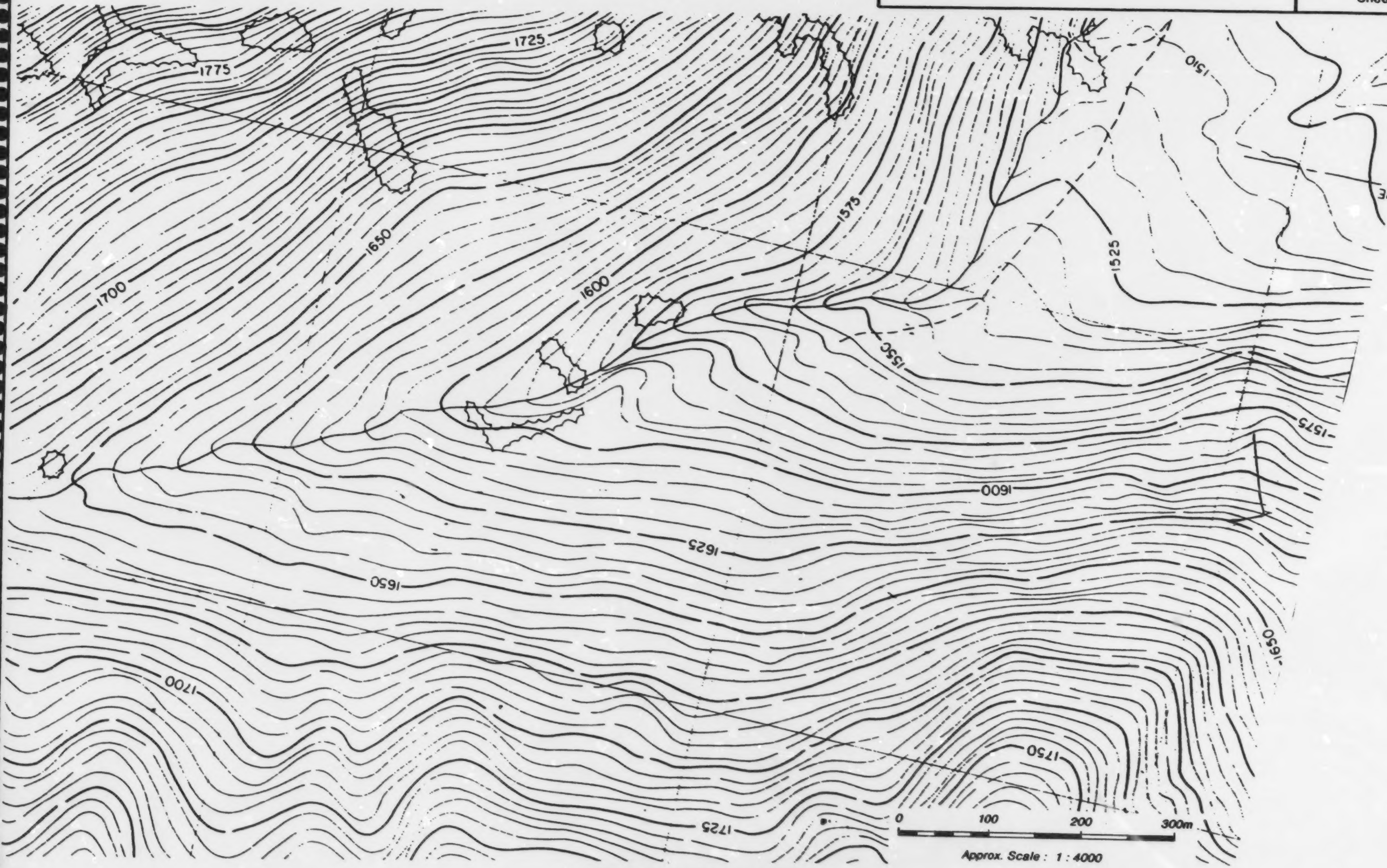
Approx. Scale : 1 : 4000

Pre – Failure Topography

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

LINE CREEK 1966 W 07/01/82

Figure 62 T
Sheet 3 of 3

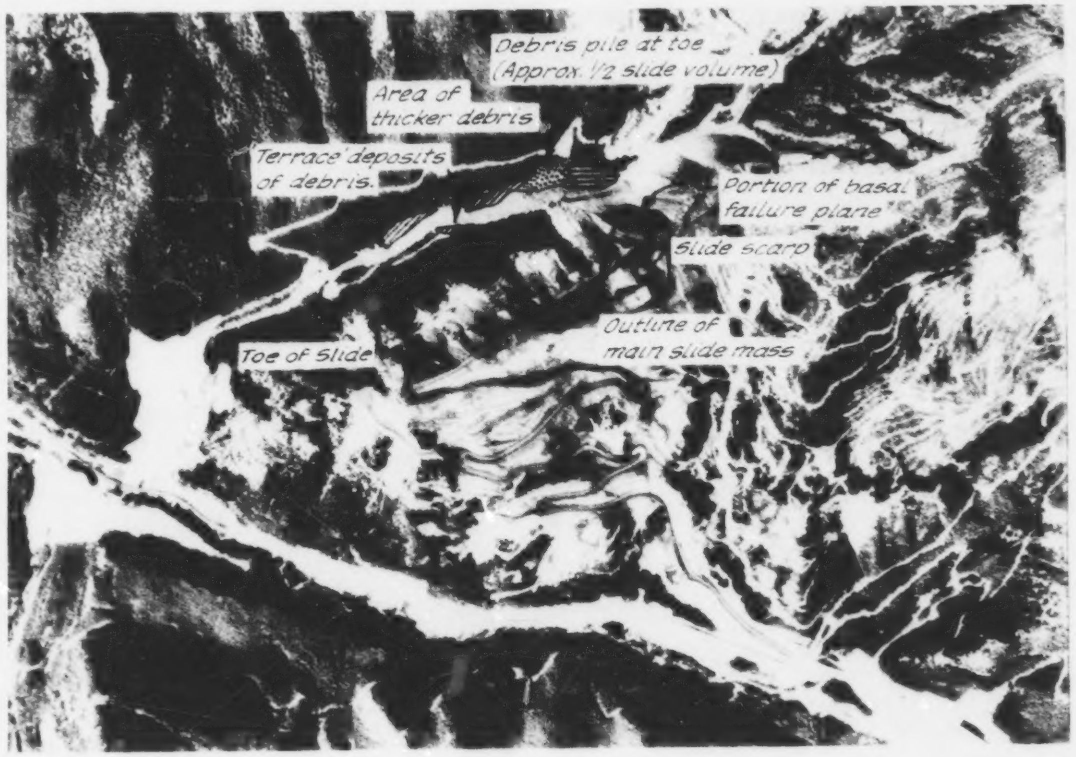

1725
1775
1700
1650
1600
1575
1525
1510
1490
1550
1575
1600
1625
1650
1650
1700
1750
1725
0
100
200
300m
Approx. Scale : 1 : 4000

ORIGINAL GROUND CONTOURS

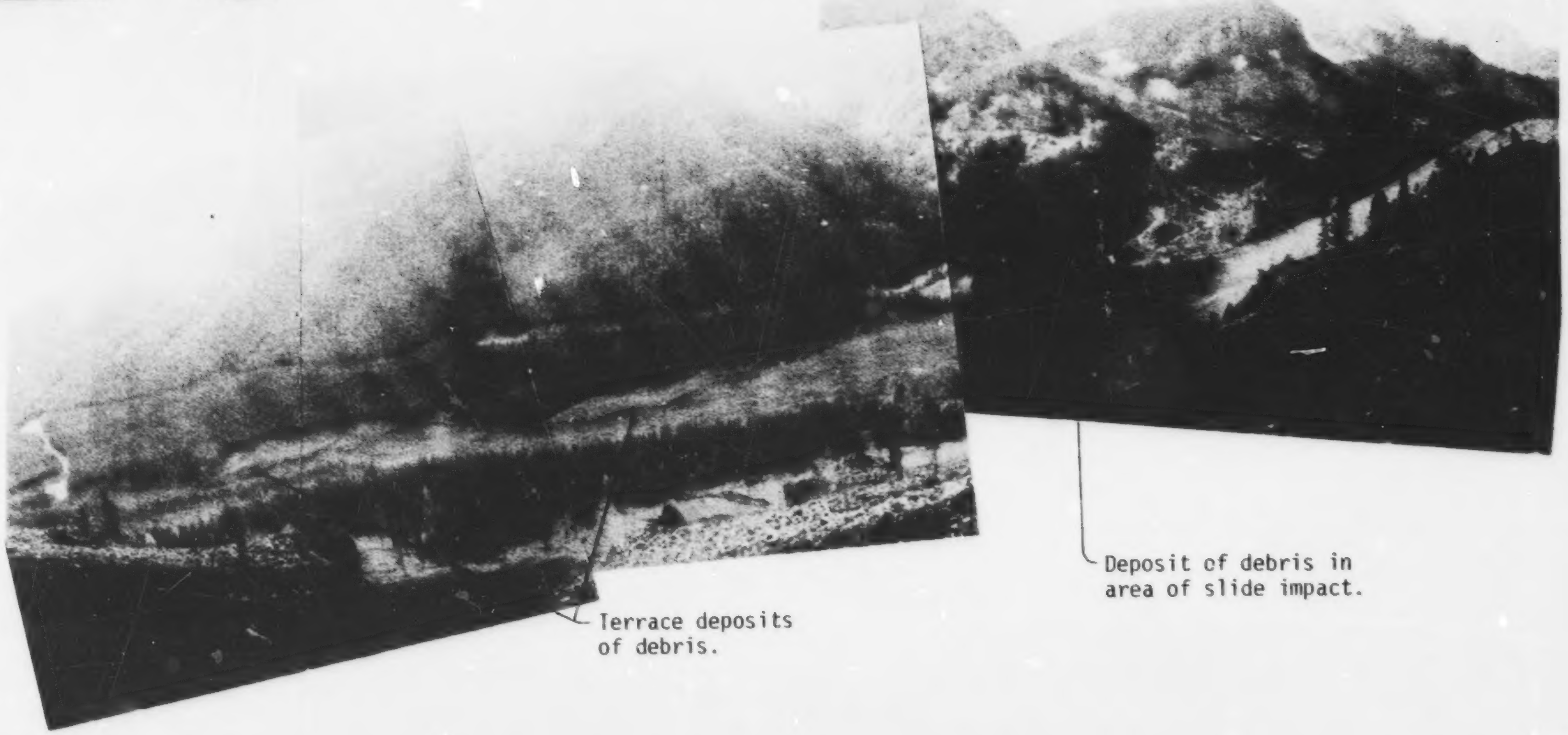
PROJECT NO. DRAWN REVIEWED DATE

LINE CREEK 1966 W 07/01/82

Figure 62 P


Debris pile at toe
(Approx. 1/2 slide volume)
Area of thicker debris
Terrace deposits of debris.
Portion of basal failure plane
Slide scarp
Outline of main slide mass
Toe of Slide

REFERENCE: Geographic Air Survey Ltd., Photo number G8209039-1-7.



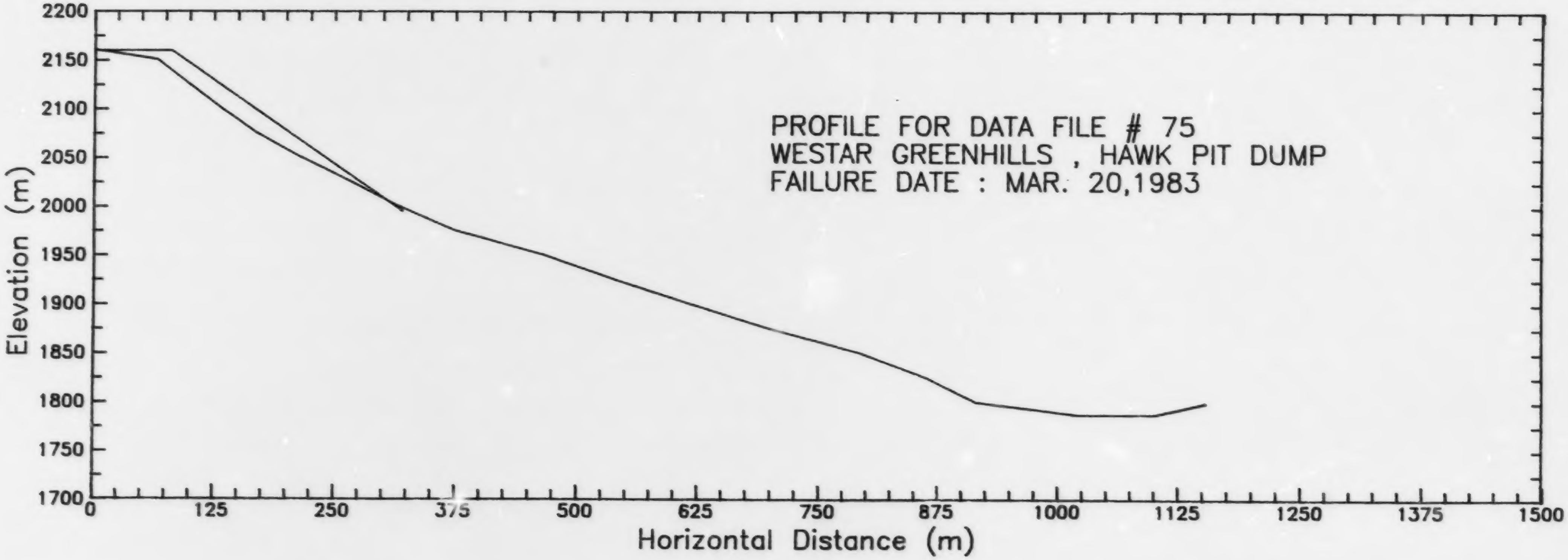
Deposit of debris in area of slide impact.

Terrace deposits of debris.

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

GREENHILLS EAST 03/20/83

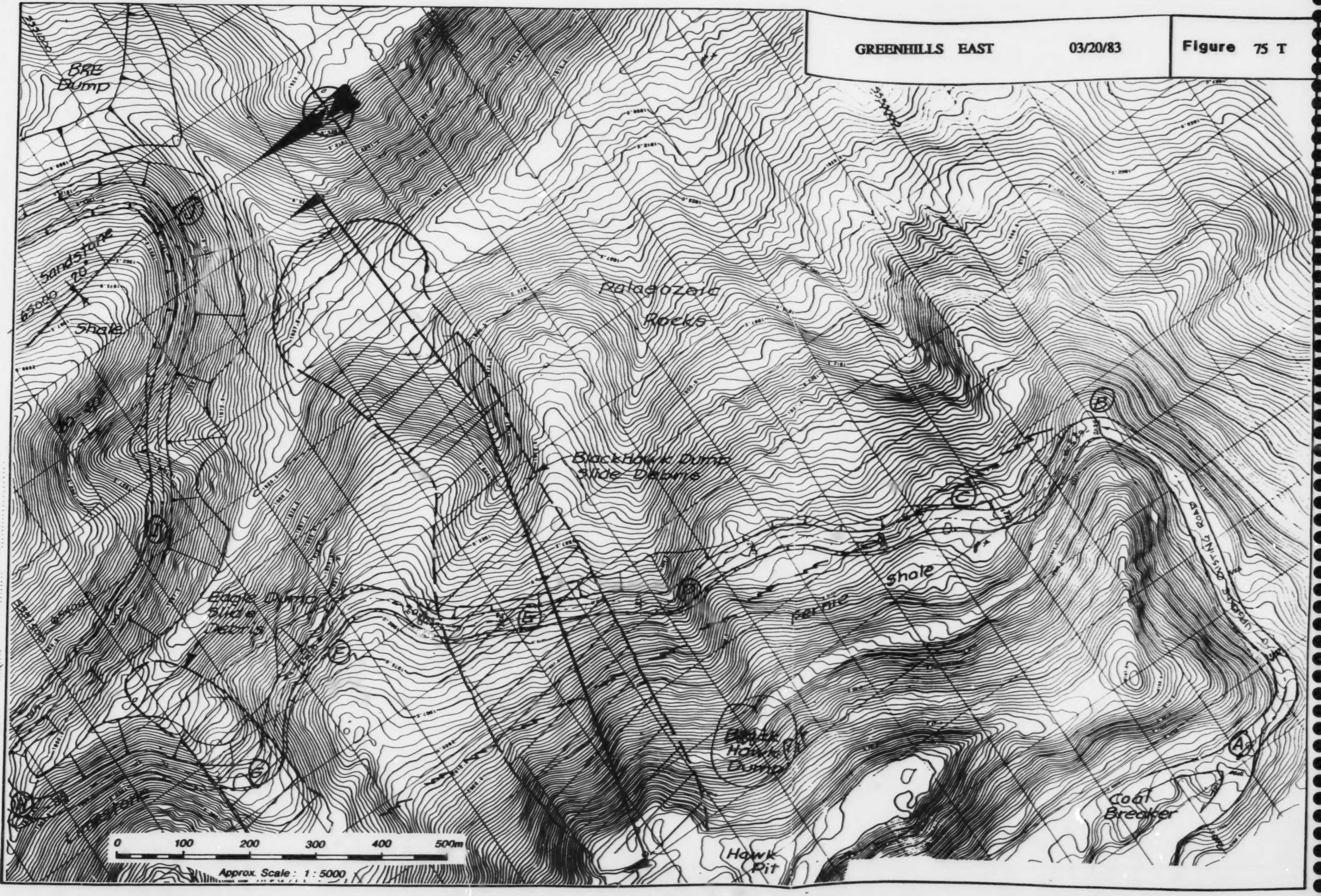
Figure 75 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

GREENHILLS EAST 03/20/83

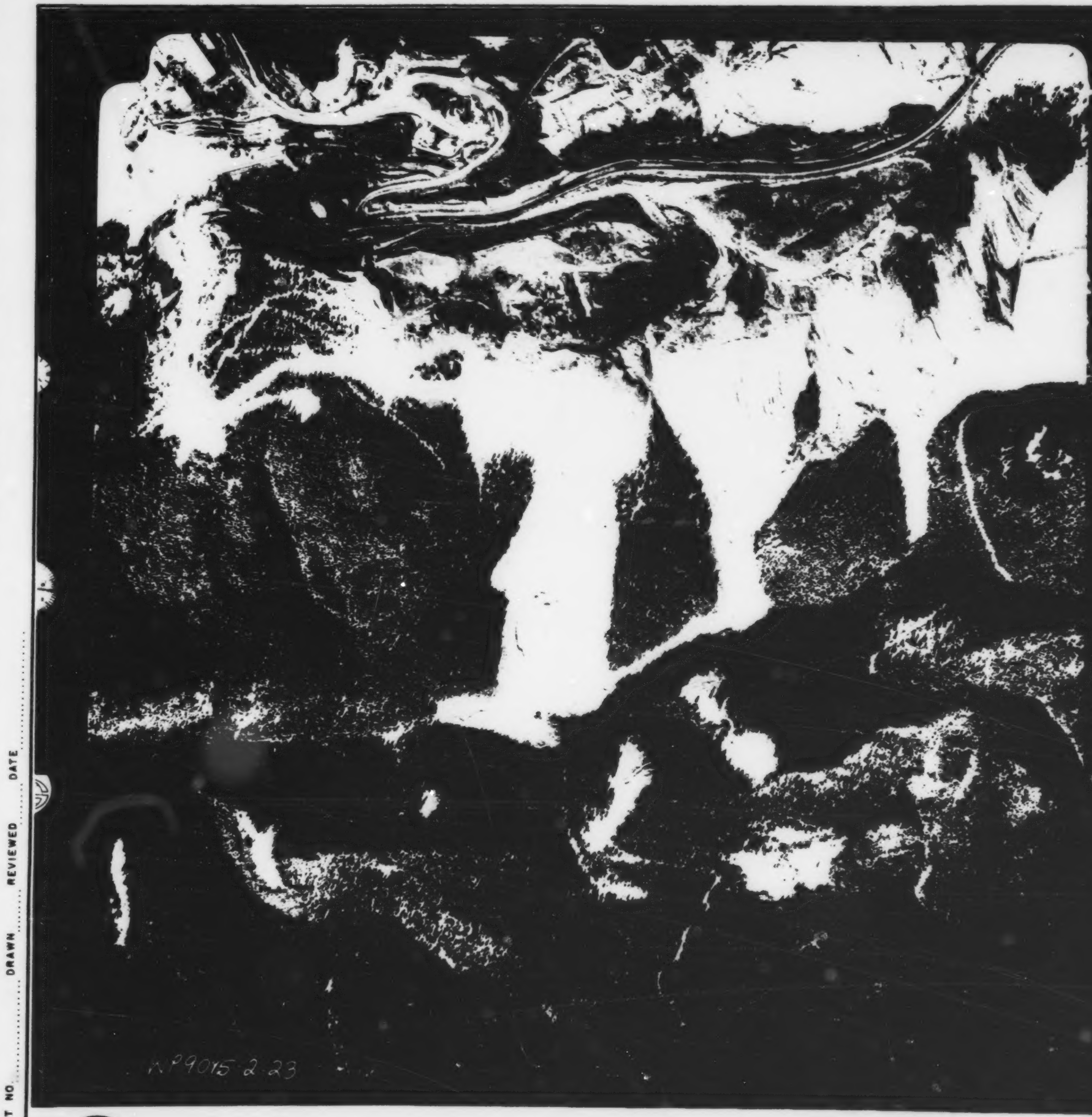
Figure 75 T

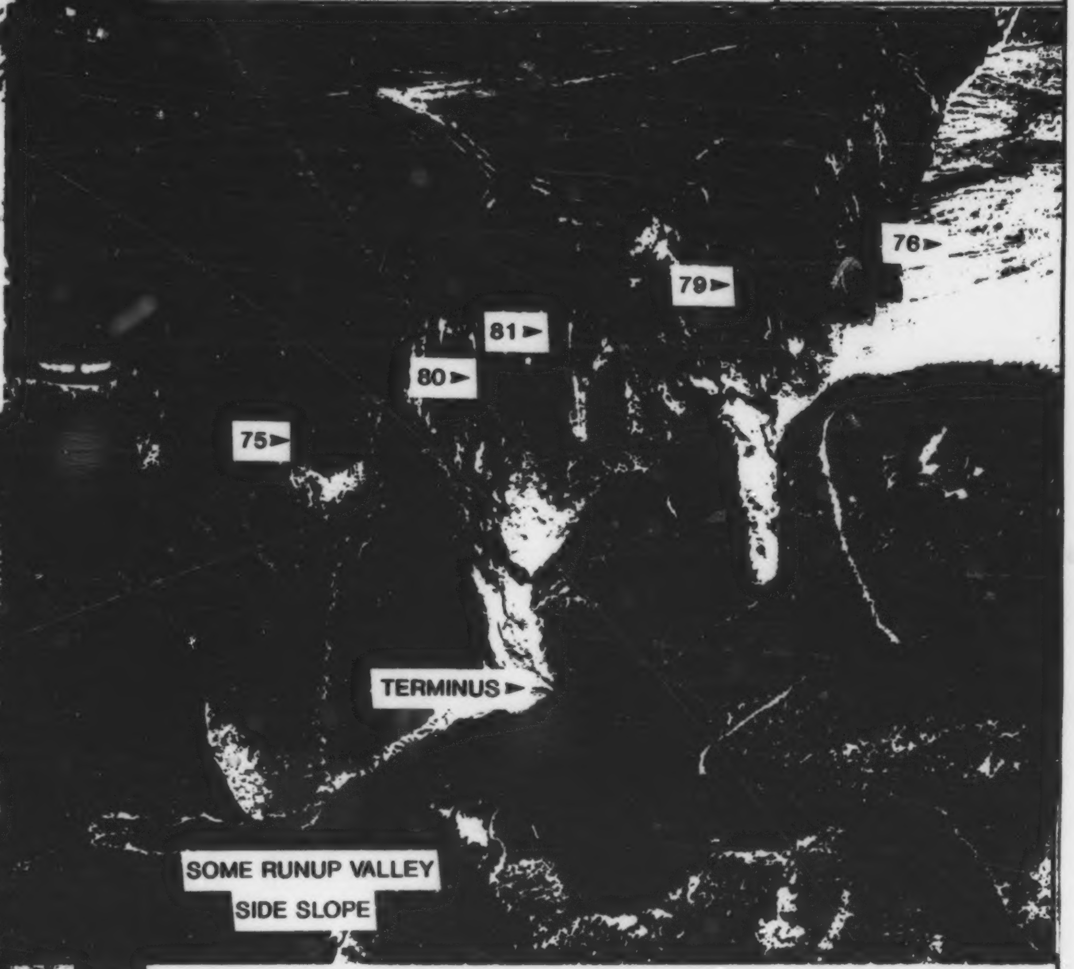

BRE Dump
Sandstone
65000 20°
Shale
Palaeozoic Rocks
Blackhawk Dump Slide Debris
Eagle Dump Slide Debris
Fernie Shale
Black Hawk Dump
Hawk Pit
Coal Breaker
Existing Road
Limestone
A
B
C
D
E
F
G
H
I
J
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

PROJECT NO. 862/044 DRAWN .... REVIEWED .... DATE Aug 86

GREENHILLS EAST 03/20/83

Figure 75 P


KP9015-2-23


76►
79►
81►
80►
75►
TERMINUS►
SOME RUNUP VALLEY
SIDE SLOPE

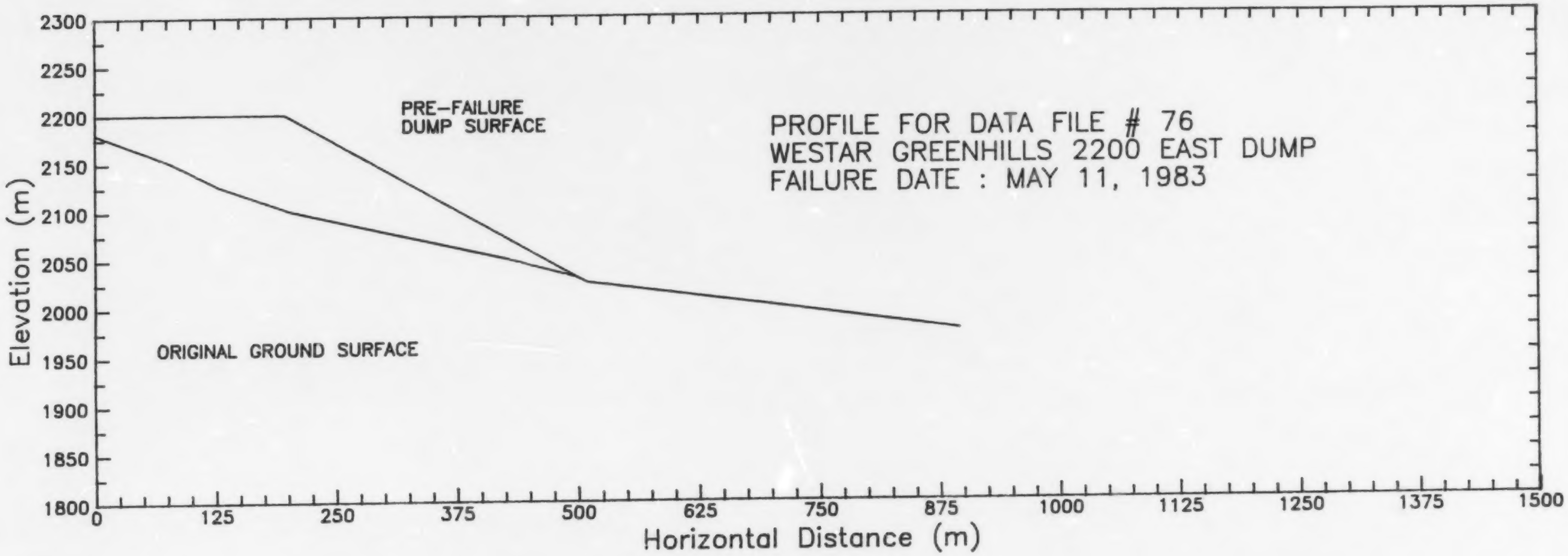
GREENHILLS EAST	05/11/83	76 P
GREENHILLS EAST	07/12/86	79 P
GREENHILLS EAST	02/12/87	80 P
GREENHILLS EAST	03/07/87	81 P

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

GEOGRAPHIC AIR SURVEY LTD.
17 AIRPORT ROAD, MUNICIPAL AIRPORT, EDMONTON, ALBERTA [illegible]

GREENHILLS EAST 05/11/83

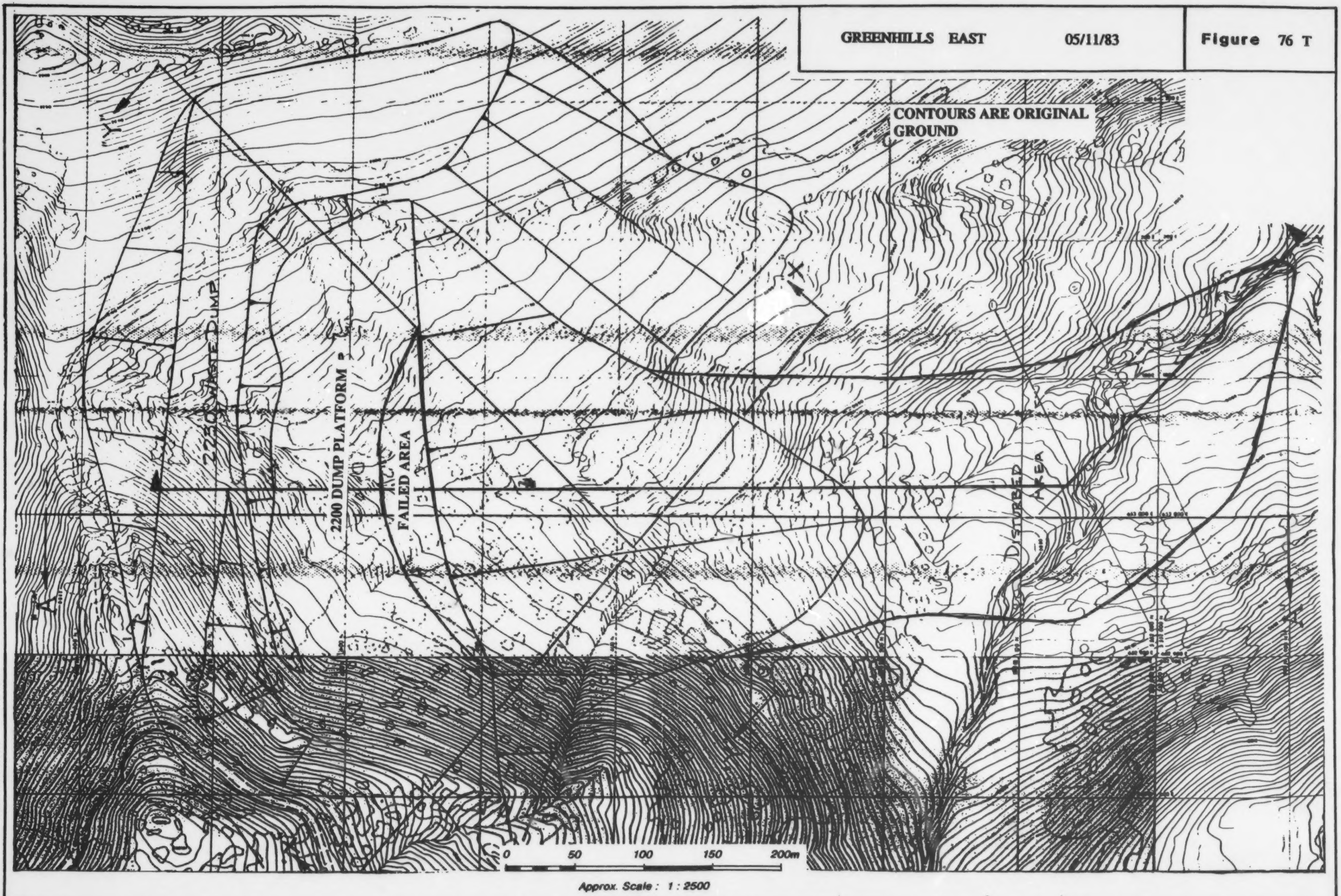
Figure 76 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

GREENHILLS EAST 05/11/83

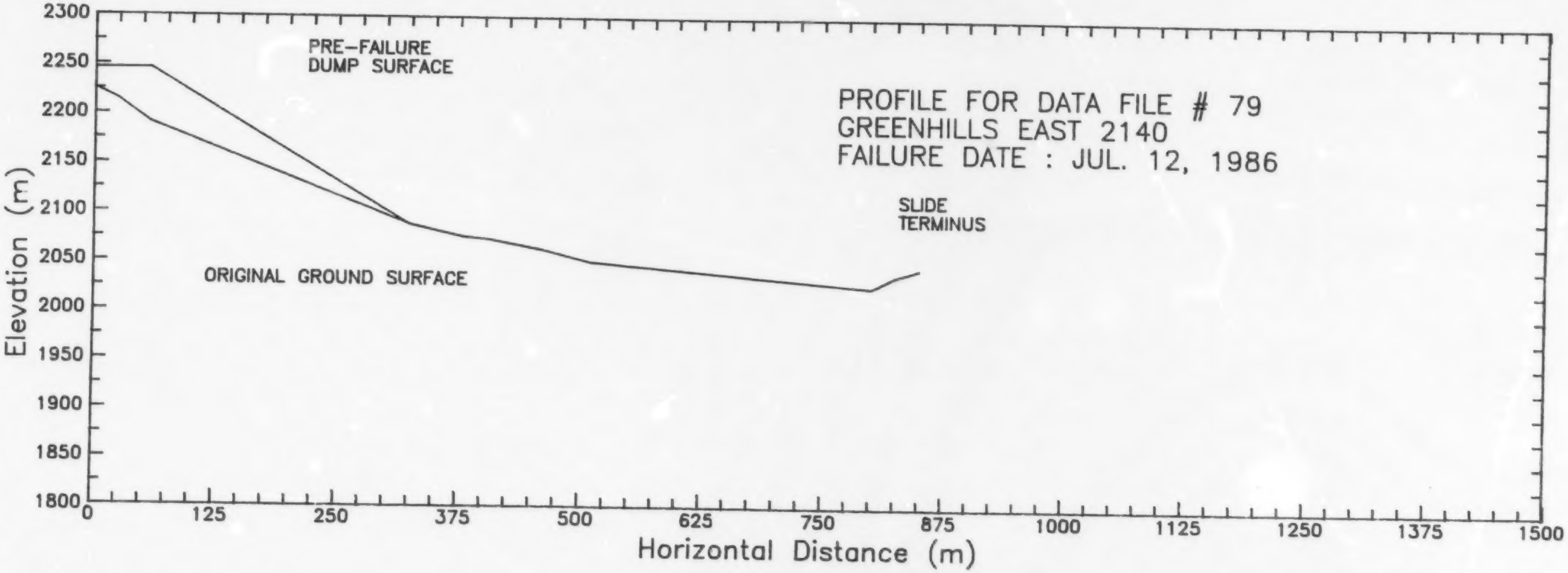
Figure 76 T


CONTOURS ARE ORIGINAL GROUND
2250 WASTE DUMP
2200 DUMP PLATFORM
FAILED AREA
DISTURBED AREA
A
A
X
Y
0
50
100
150
200m
Approx. Scale : 1 : 2500

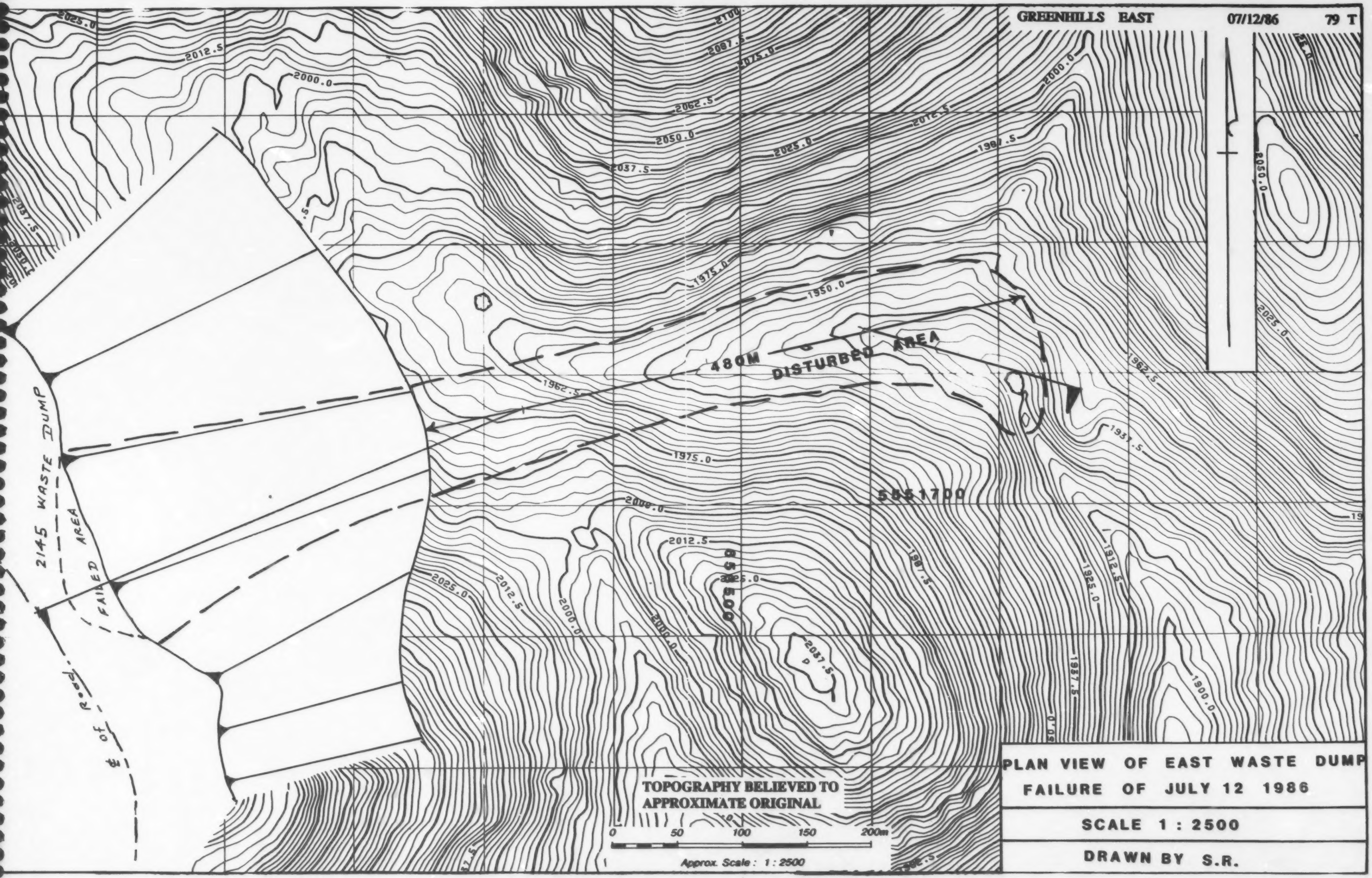
PROJECT NO. .... DRAWN .... REVIEWED .... DATE

GREENHILLS EAST 07/12/86

Figure 79 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91


GREENHILLS EAST
07/12/86
79 T
2145 WASTE DUMP
FAILED AREA
℄ of Road
480M
DISTURBED AREA
5551700
650500
TOPOGRAPHY BELIEVED TO
APPROXIMATE ORIGINAL
0
50
100
150
200m
Approx. Scale : 1 : 2500
2100
2087.5
2075.0
2062.5
2050.0
2037.5
2025.0
2012.5
2000.0
1987.5
1975.0
1962.5
1950.0
1937.5
1925.0
1912.5
1900.0

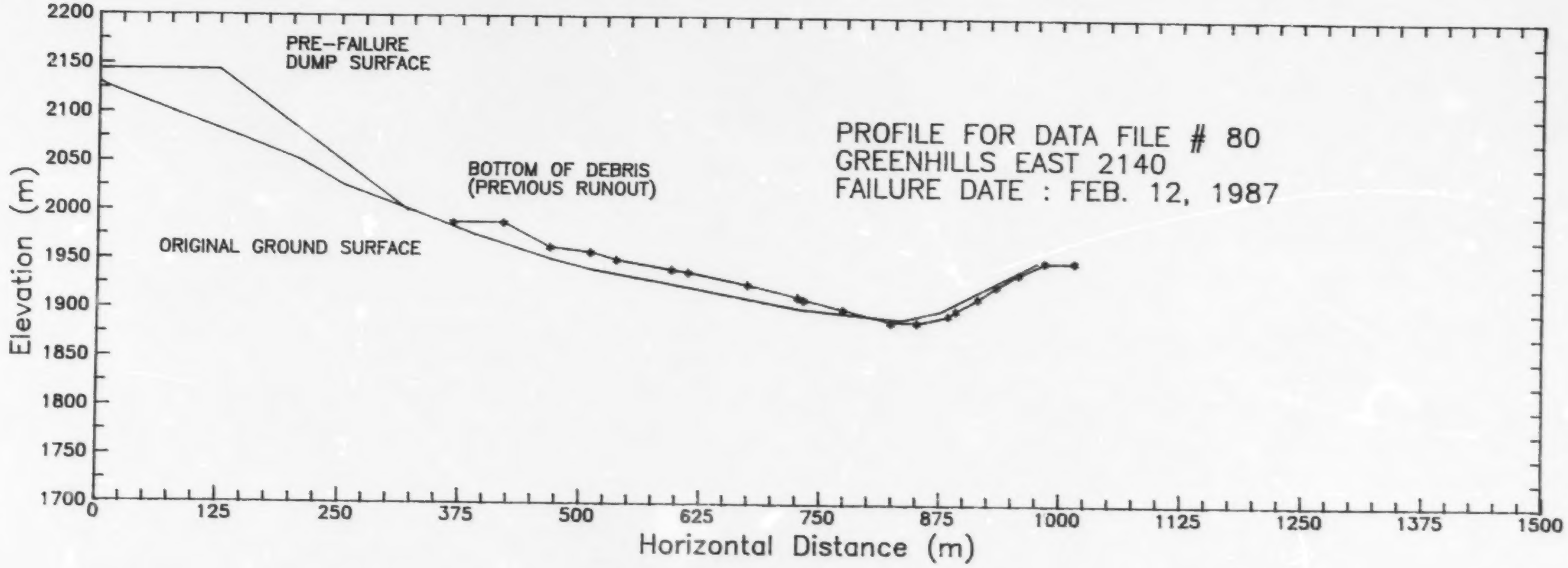
PLAN VIEW OF EAST WASTE DUMP
FAILURE OF JULY 12 1986

SCALE 1 : 2500

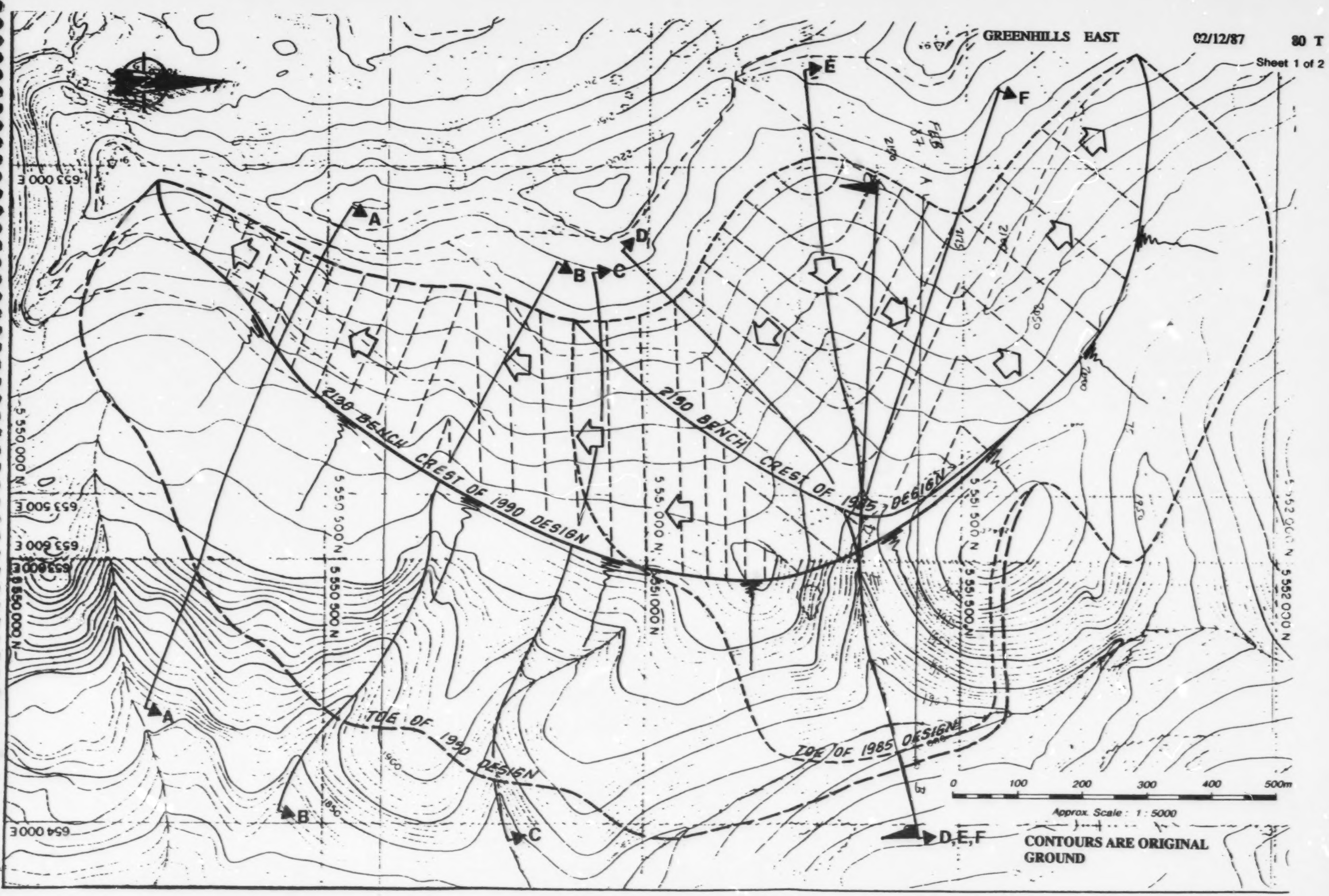
DRAWN BY S.R.

GREENHILLS EAST **02/12/87**

Figure 80 S



PROJECT NO. 912-1413 DRAWN ...... REVIEWED ...... DATE Sept. 91

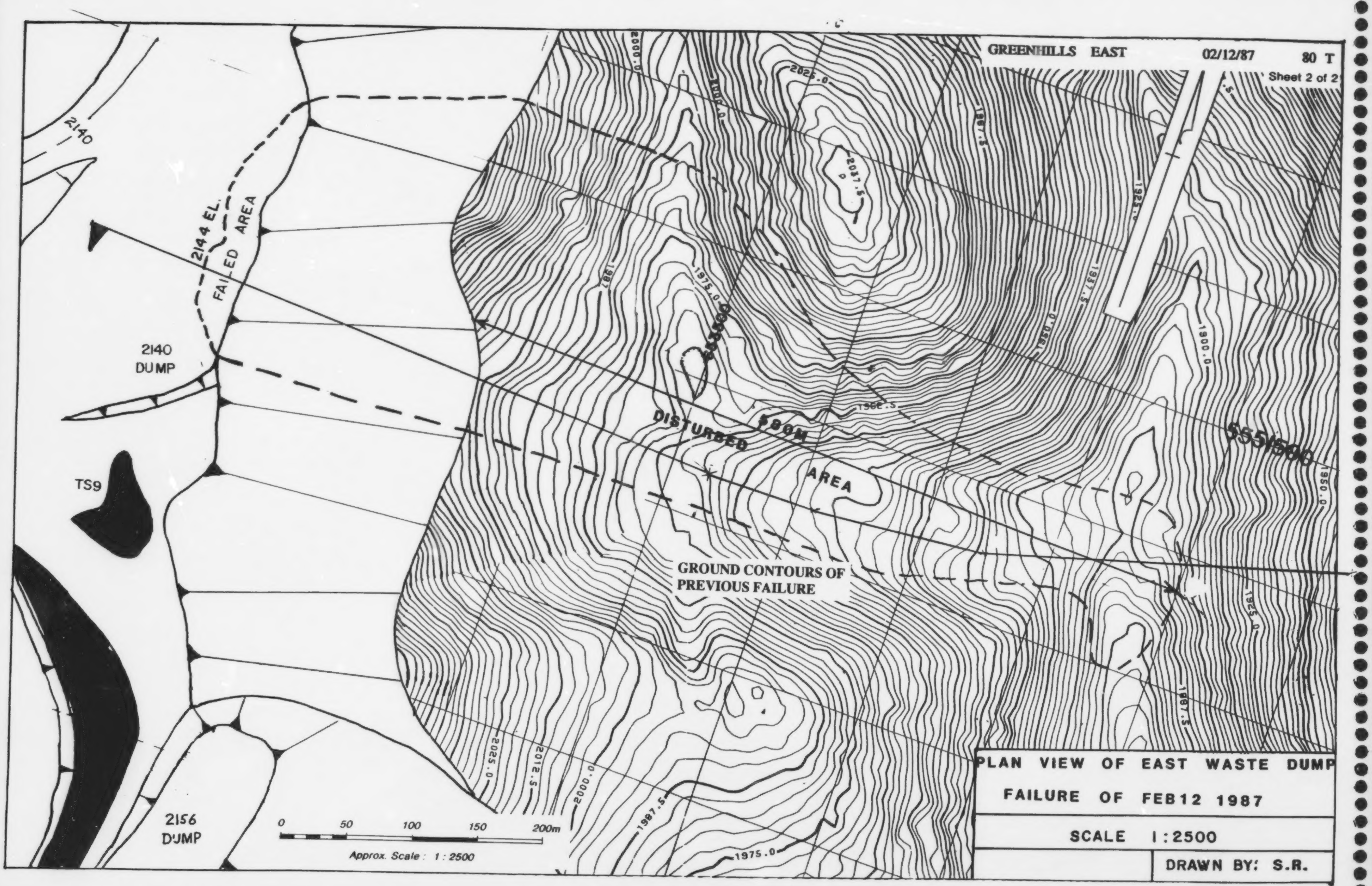


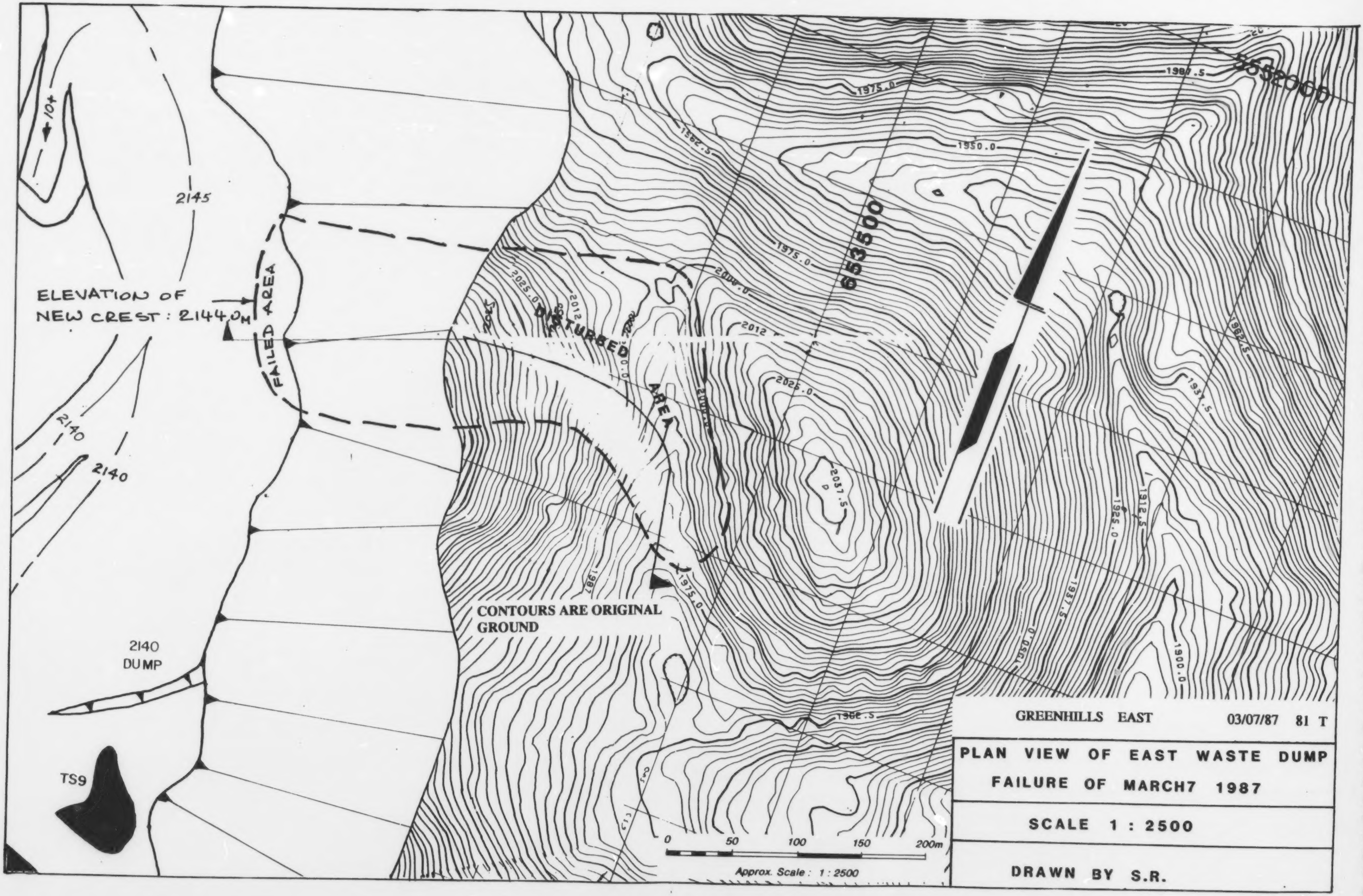
GREENHILLS EAST 02/12/87 80 T

Sheet 1 of 2

CONTOURS ARE ORIGINAL GROUND

A
B
C
D
E
F
D,E,F
2130 BENCH CREST OF 1990 DESIGN
2190 BENCH CREST OF 1985 DESIGN
TOE OF 1990 DESIGN
TOE OF 1985 DESIGN
653 000 E
653 500 E
653 900 E
653 800 E
654 000 E
5 550 000 N
5 550 500 N
5 550 900 N
5 551 000 N
5 551 500 N
5 552 000 N
FEB 87
2190
2175
2150
2050
1950
1900
1850
0
100
200
300
400
500m
Approx. Scale : 1 : 5000


GREENHILLS EAST
02/12/87
80 T
Sheet 2 of 2
2140
2144 EL.
FAILED AREA
2140
DUMP
TS9
2156
DUMP
2000.0
2025.0
2037.5
1987.5
1975.0
1962.5
1925.0
1900.0
1950.0
555/500
DISTURBED AREA
590M
GROUND CONTOURS OF PREVIOUS FAILURE
2025.0
2012.5
2000.0
1987.5
1975.0
0
50
100
150
200m
Approx. Scale : 1 : 2500
PLAN VIEW OF EAST WASTE DUMP
FAILURE OF FEB12 1987
SCALE 1:2500
DRAWN BY: S.R.


ELEVATION OF NEW CREST : 2144.0M
FAILED AREA
DISTURBED AREA
10+
2145
2140
2140
2140
DUMP
TS9
CONTOURS ARE ORIGINAL GROUND
653500
5552000
1987.5
1975.0
1962.5
1950.0
1975.0
2000.0
2012
2025.0
2037.5
1982.5
1937.5
1912.5
1925.0
1900.0
1950.0
1962.5
1975.0
1987
0
50
100
150
200m
Approx. Scale : 1 : 2500

GREENHILLS EAST 03/07/87 81 T

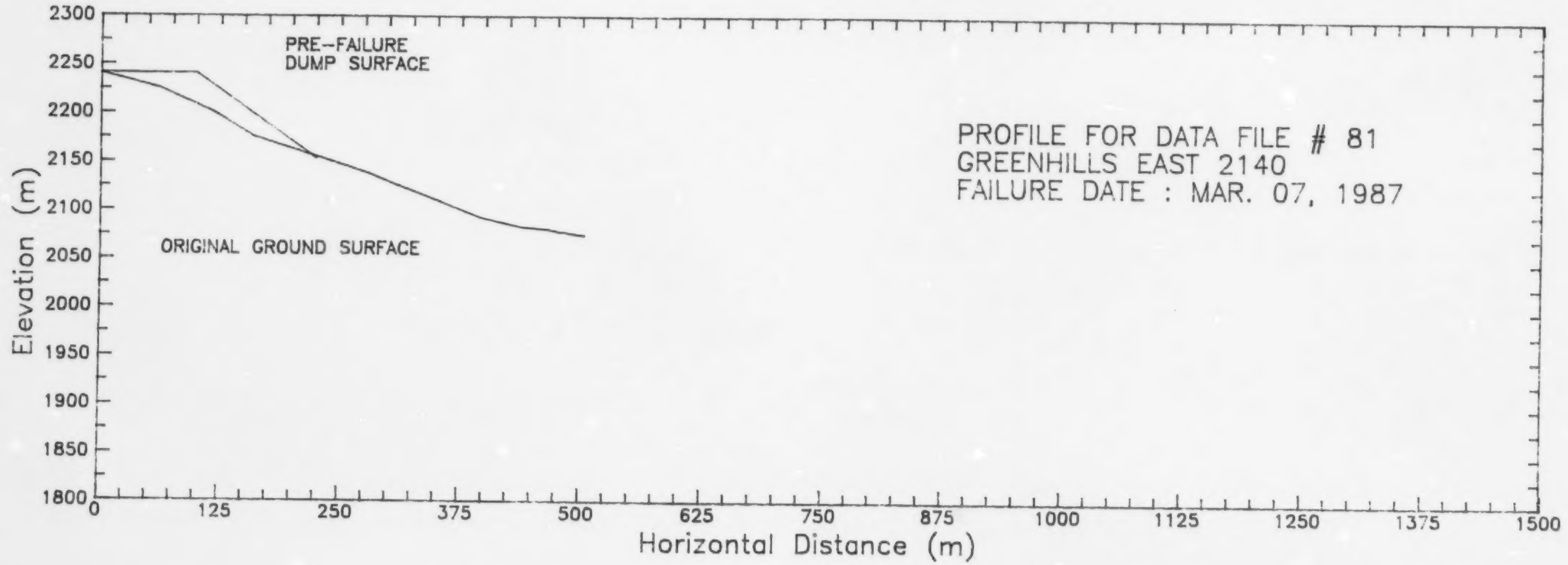
PLAN VIEW OF EAST WASTE DUMP
FAILURE OF MARCH7 1987

SCALE 1 : 2500

DRAWN BY S.R.

GREENHILLS EAST 03/07/87

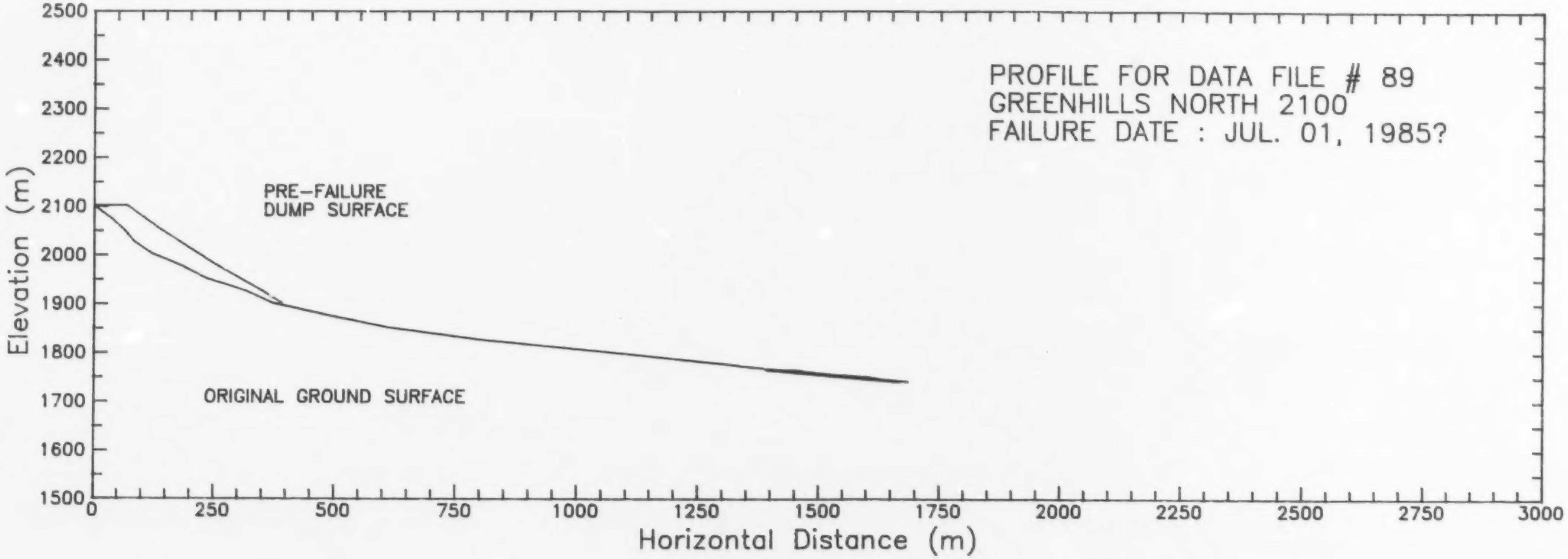
Figure 81 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

GREENHILLS NORTH **07/01/85**

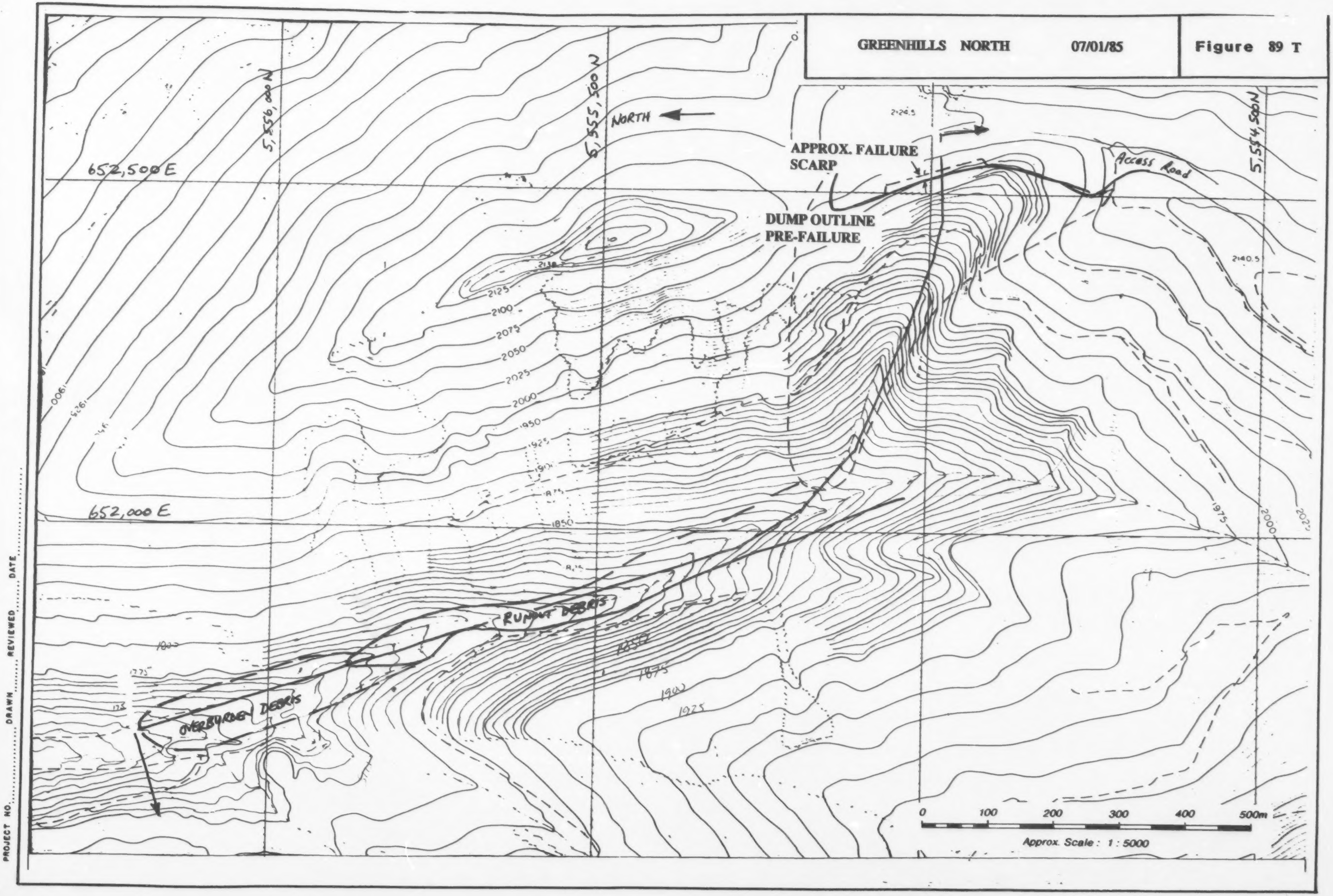
Figure 89 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

GREENHILLS NORTH 07/01/85

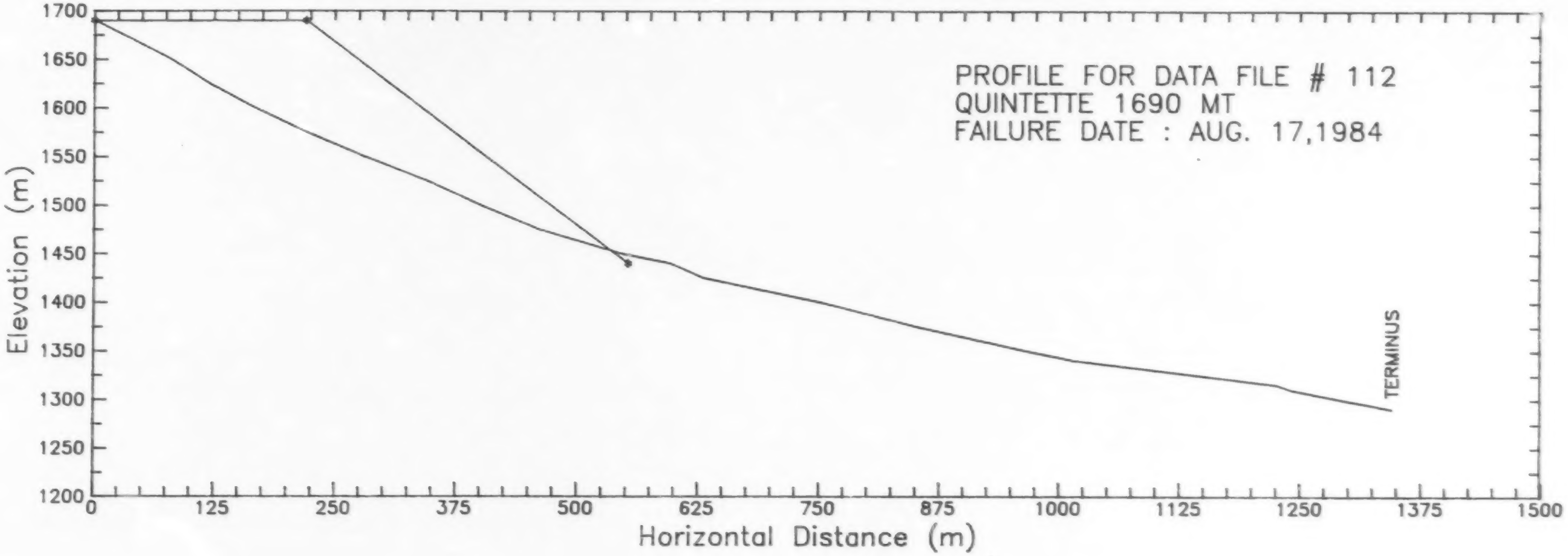
Figure 89 T


NORTH
652,500 E
652,000 E
5,556,000 N
5,555,500 N
5,554,500 N
APPROX. FAILURE SCARP
DUMP OUTLINE PRE-FAILURE
Access Road
RUNOUT DEBRIS
OVERBURDEN DEBRIS
2128.5
2126.5
2140.5
2125
2100
2075
2050
2025
2000
1950
1925
1900
1875
1850
1825
1800
1775
1975
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

QCL 1690MT 08/17/84

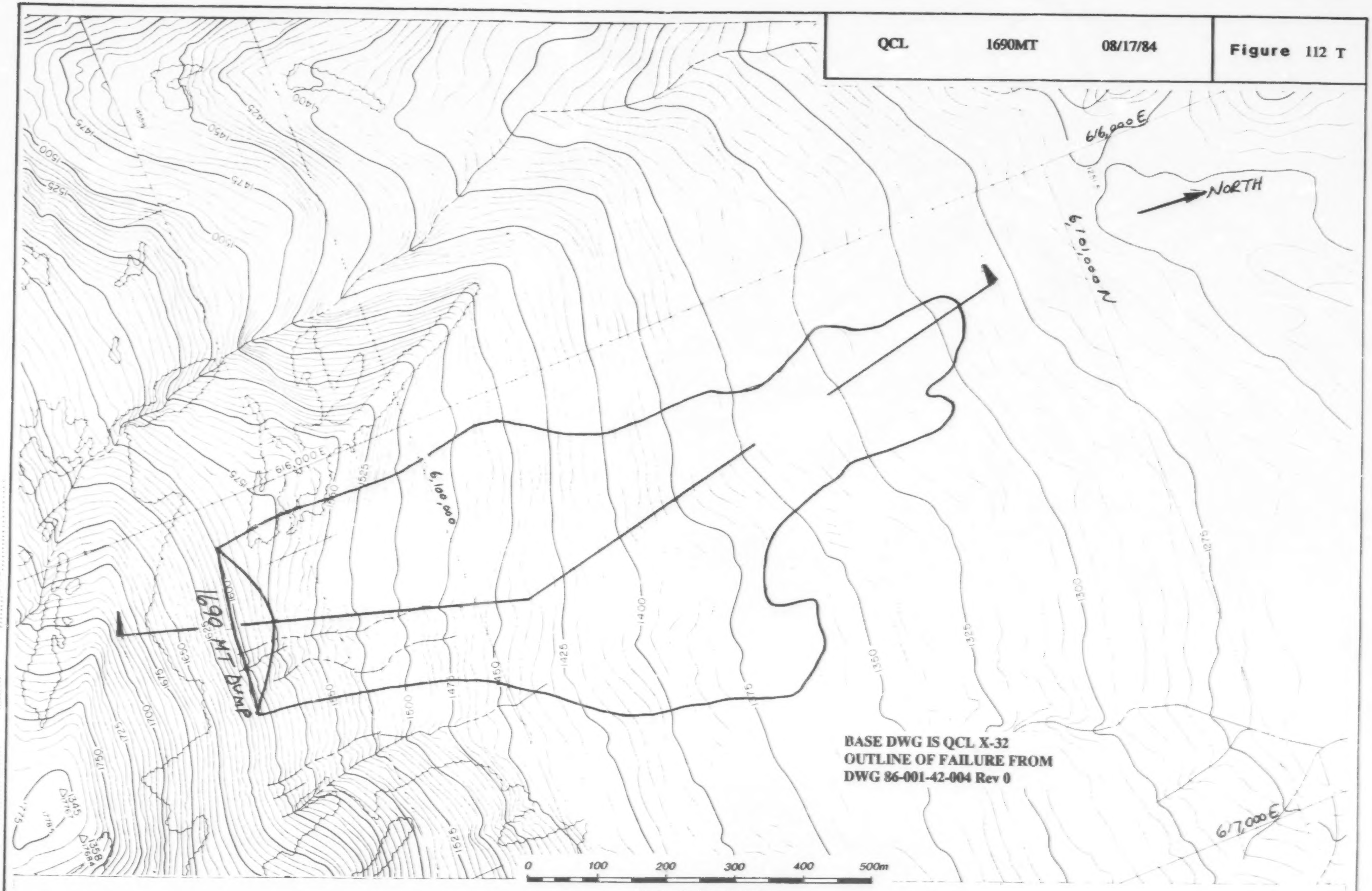
Figure 112 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

QCL 1690MT 08/17/84

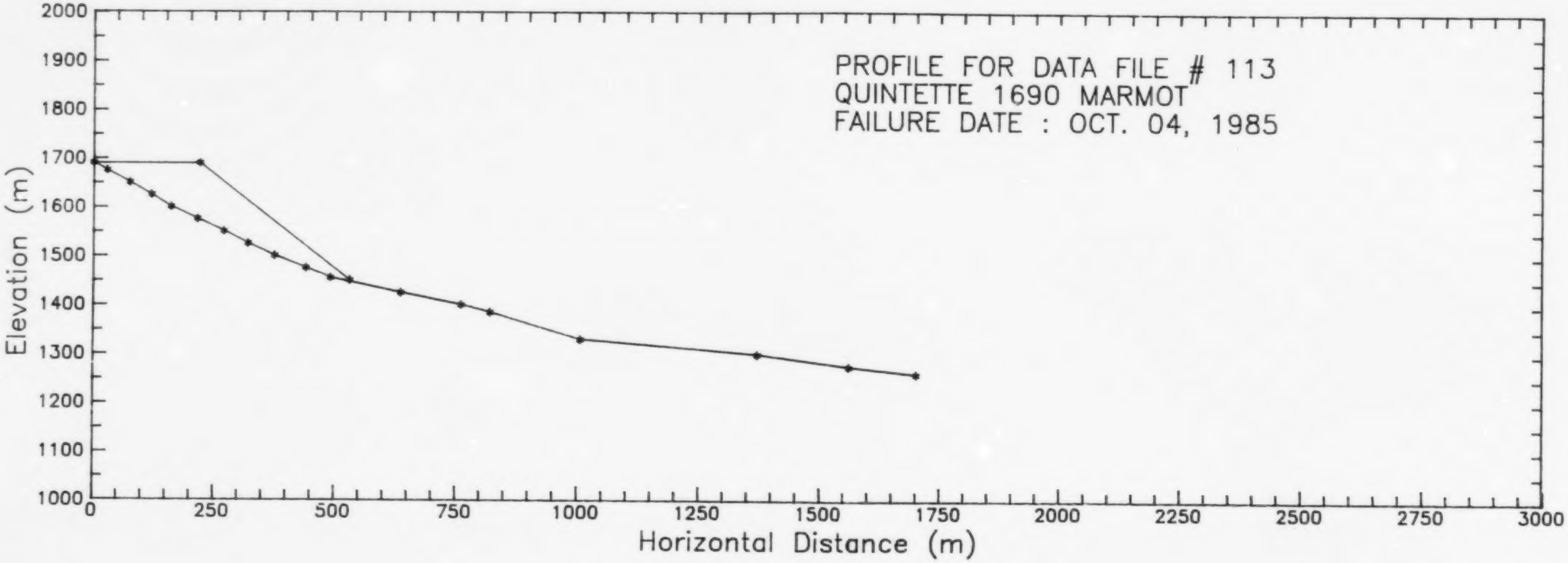
Figure 112 T


616,000 E
NORTH
6,100,000 N
616,000 E
6,100,000
1690 MT DUMP
617,000 E
1400
1425
1450
1475
1500
1525
1550
1575
1600
1625
1650
1675
1700
1725
1750
1375
1350
1325
1300
1275
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

BASE DWG IS QCL X-32
OUTLINE OF FAILURE FROM
DWG 86-001-42-004 Rev 0

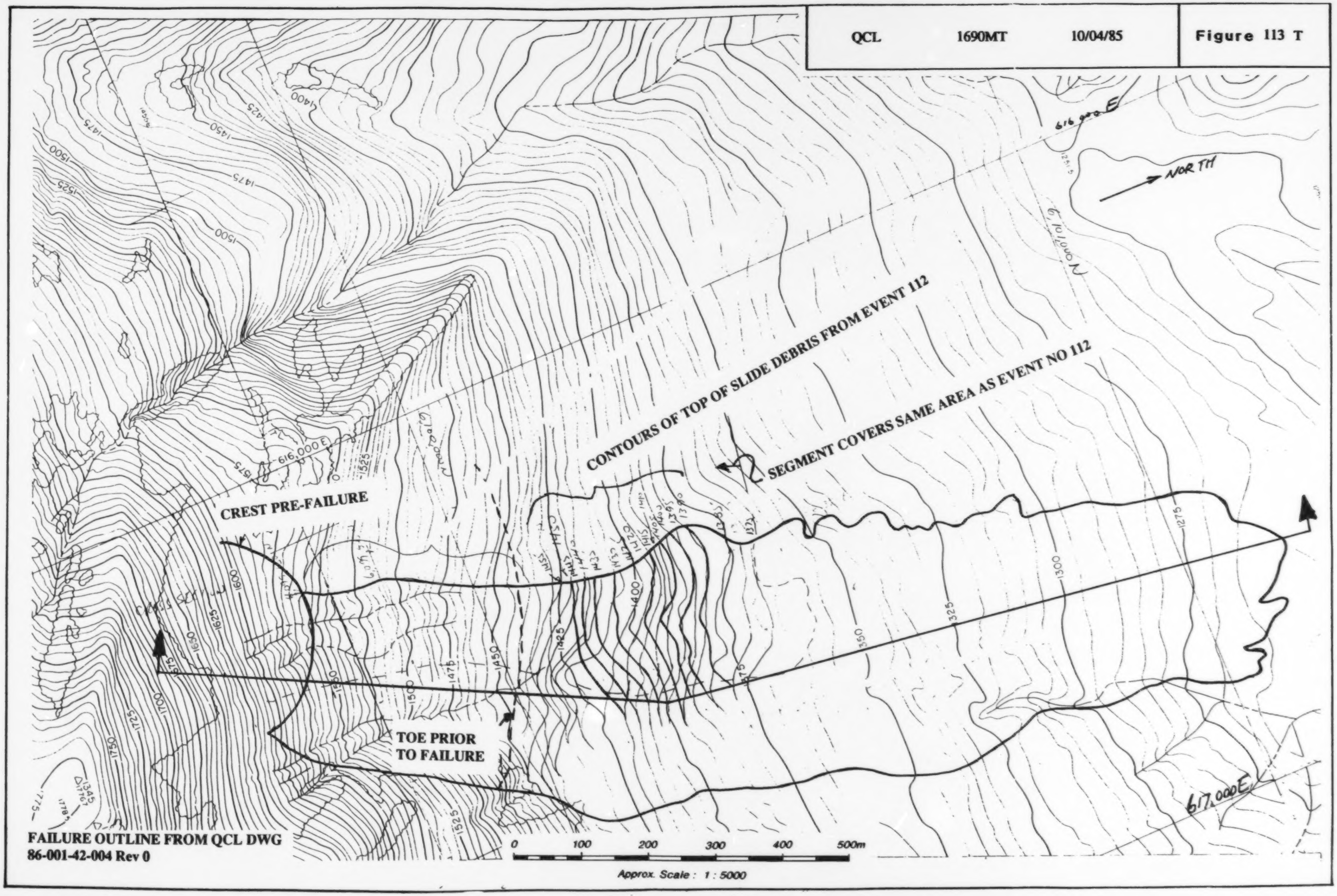
PROJECT NO .... DRAWN .... REVIEWED .... DATE ....

QCL	1690MT	10/04/85	**Figure** 113 S



PROJECT NO 912-1413 DRAWN ...... REVIEWED ...... DATE Sept '91

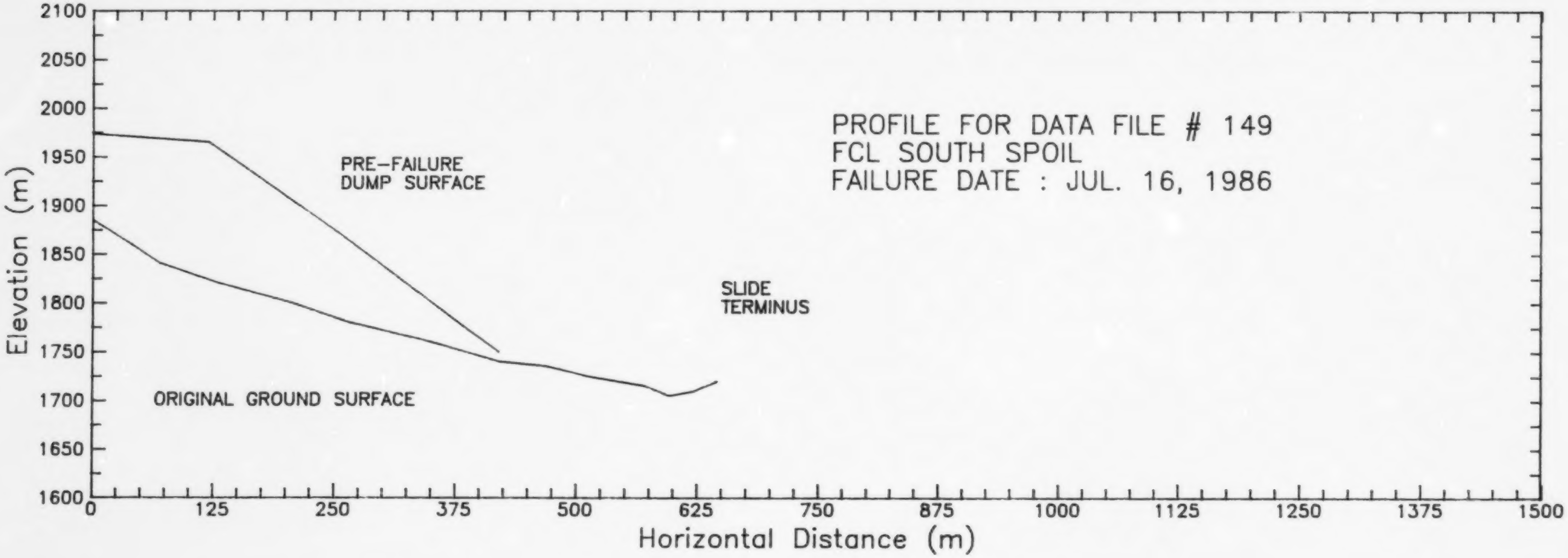
QCL	1690MT	10/04/85	Figure 113 T


NORTH
616 000 E
616,000 E
617,000E
6,010,000 N
CONTOURS OF TOP OF SLIDE DEBRIS FROM EVENT 112
SEGMENT COVERS SAME AREA AS EVENT NO 112
CREST PRE-FAILURE
TOE PRIOR TO FAILURE
Cross Section
1400
1425
1450
1475
1500
1525
1575
1600
1625
1650
1675
1700
1725
1750
1775
1350
1325
1300
1275
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

FAILURE OUTLINE FROM QCL DWG 86-001-42-004 Rev 0

FCL **BLAINE** **06/16/86**

Figure 149 S



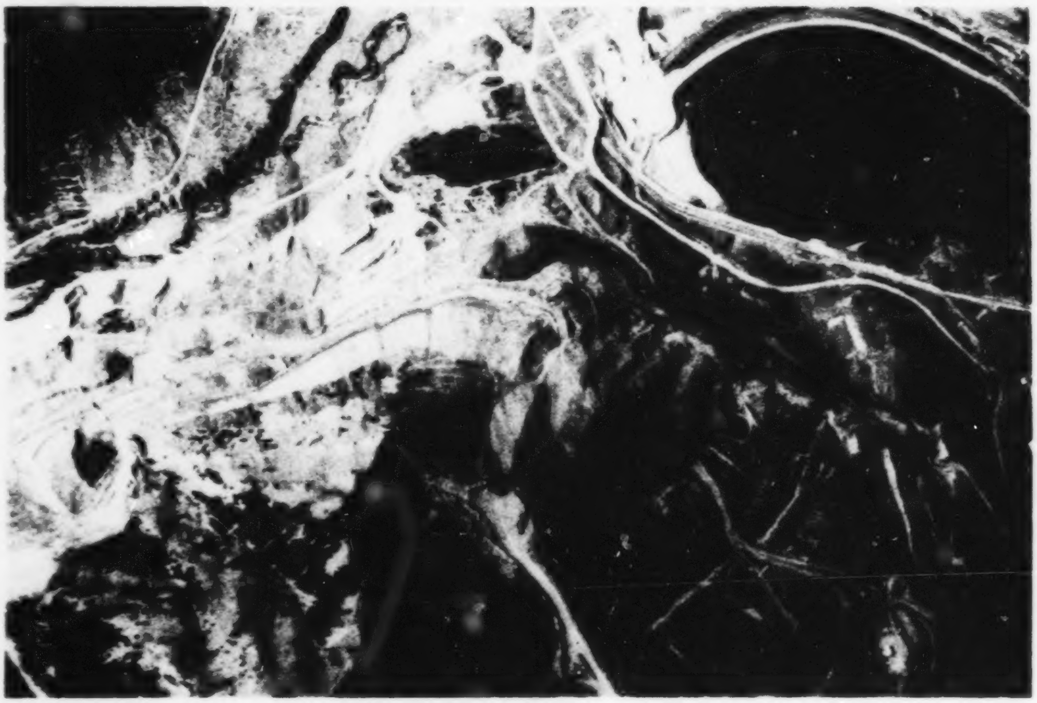
PROFILE FOR DATA FILE # 149
FCL SOUTH SPOIL
FAILURE DATE : JUL. 16, 1986

PROJECT NO. 912-1413 DRAWN ...... REVIEWED ...... DATE Sept. 91

PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

FCL BLAINE 06/16/86

Figure 149 P

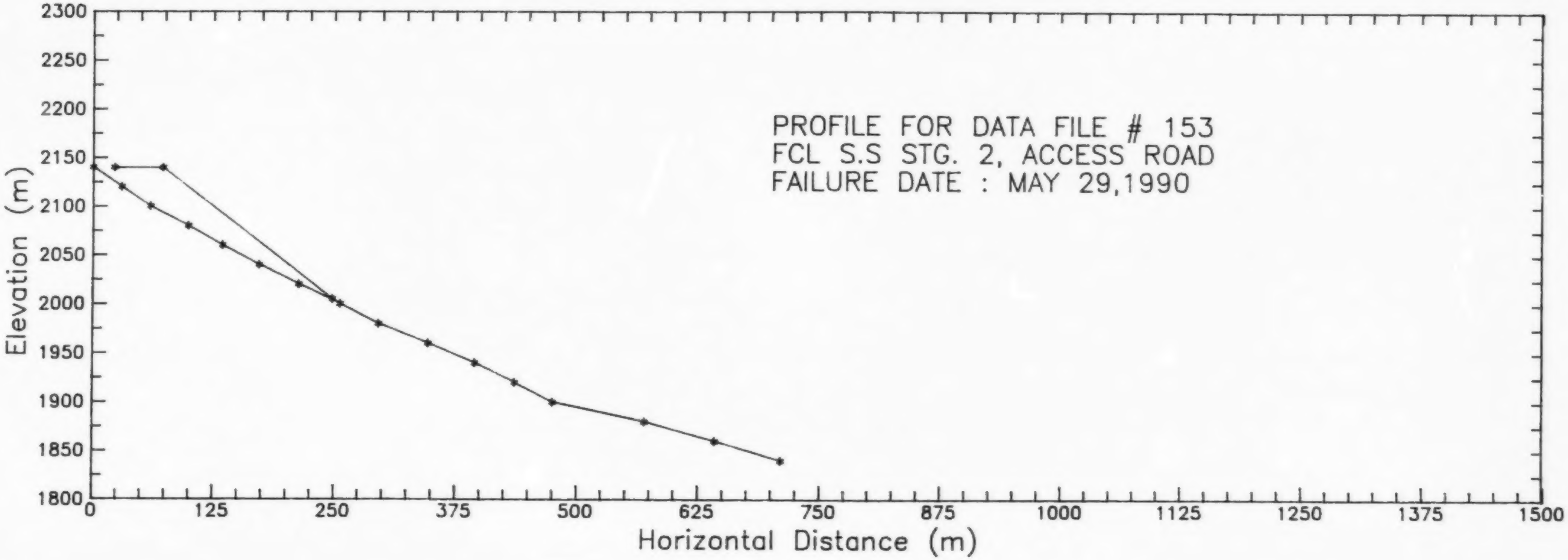


GRADUAL FAILURE ARRESTED BY TOE BERM

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

FCL SS STG 2 05/29/90

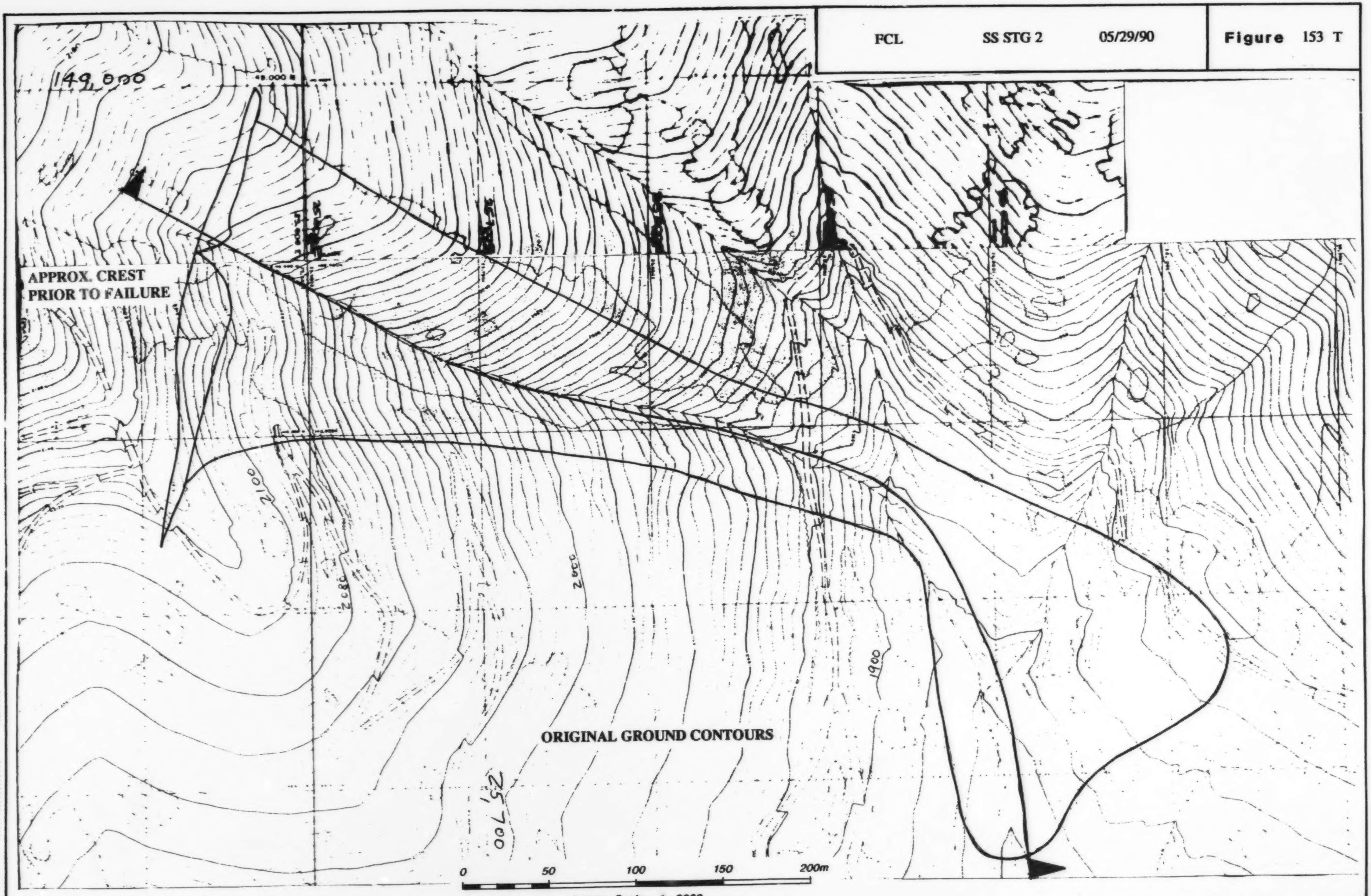
Figure 153 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

FCL SS STG 2 05/29/90

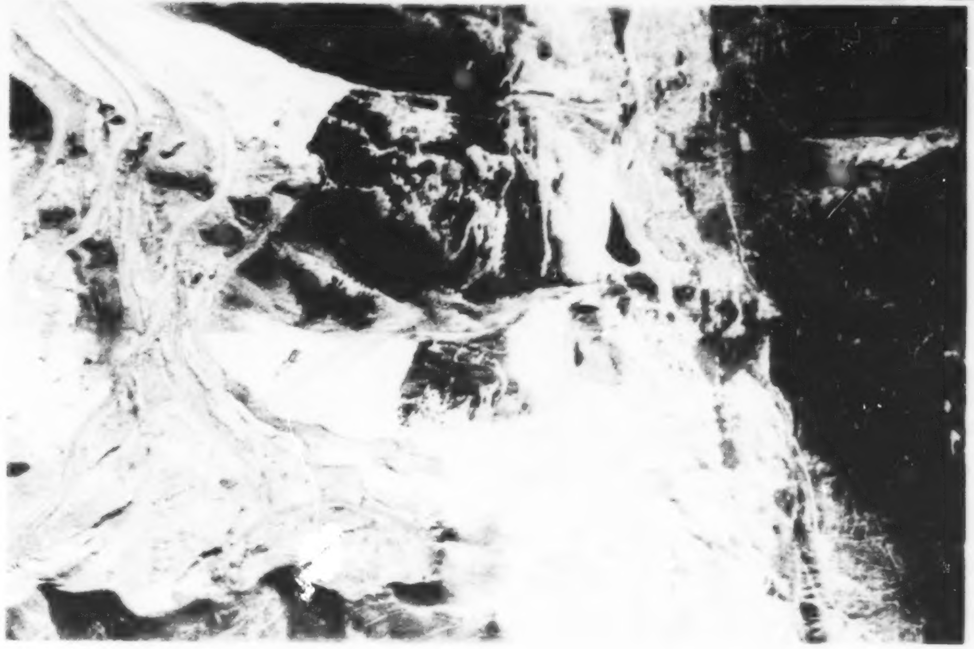
Figure 153 T

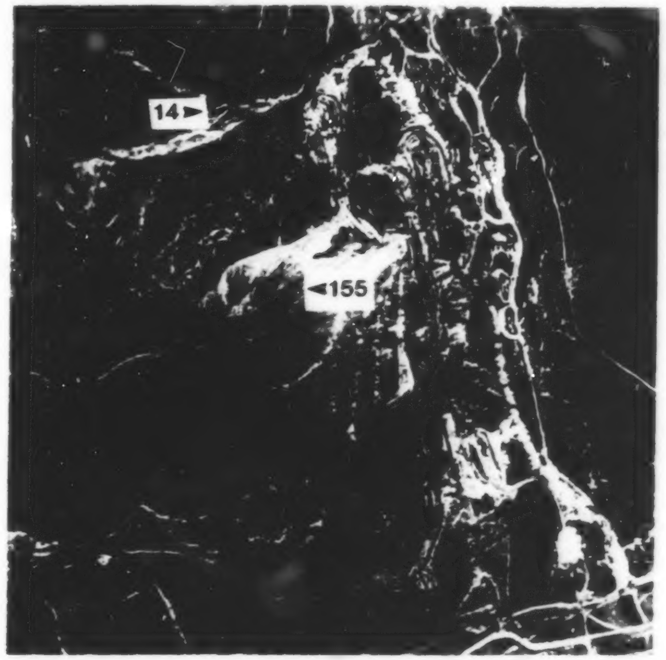

149,000
APPROX. CREST PRIOR TO FAILURE
2100
2080
2000
1900
25,700
ORIGINAL GROUND CONTOURS
0
50
100
150
200m

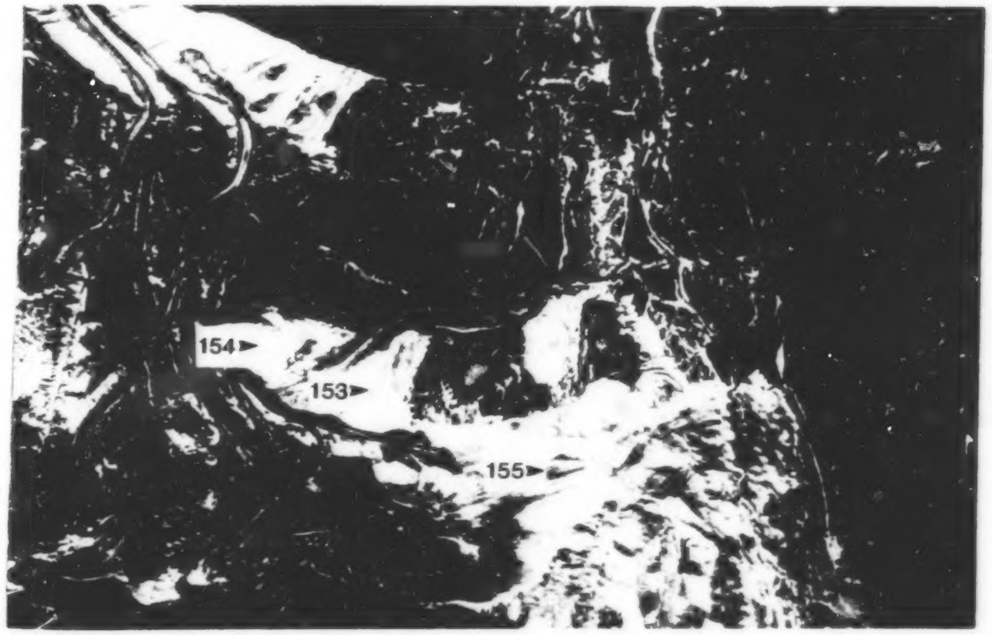
Approx. Scale : 1 : 2000

PROJECT NO. .... DRAWN .... REVIEWED .... DATE

			Figure
FCL	SS STG 2	05/29/90	153 P
FCL	SS STG 2	07/07/90	154 P
FCL	SOUTH SPOIL	10/29/89	155 P



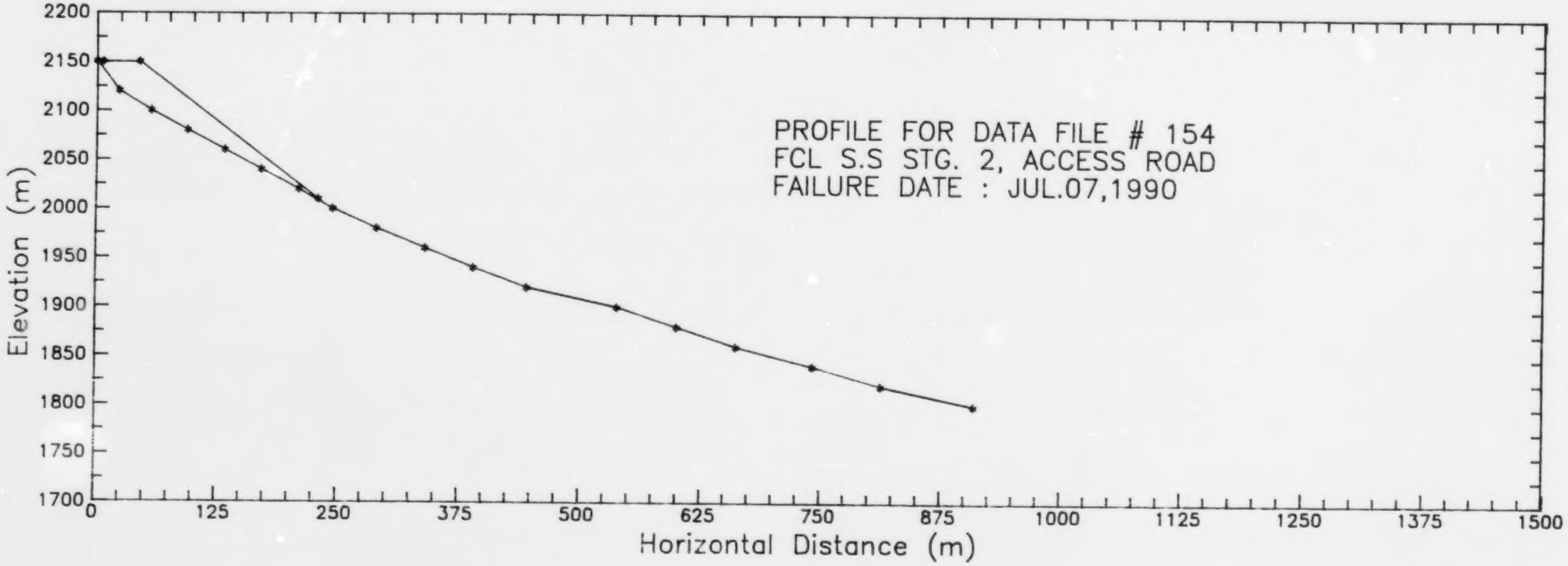




PRE - FAILURE

PROJECT NO .... DRAWN .... REVIEWED .... DATE ....

FCL **SS STG 2** **07/07/90** **Figure 154 S**

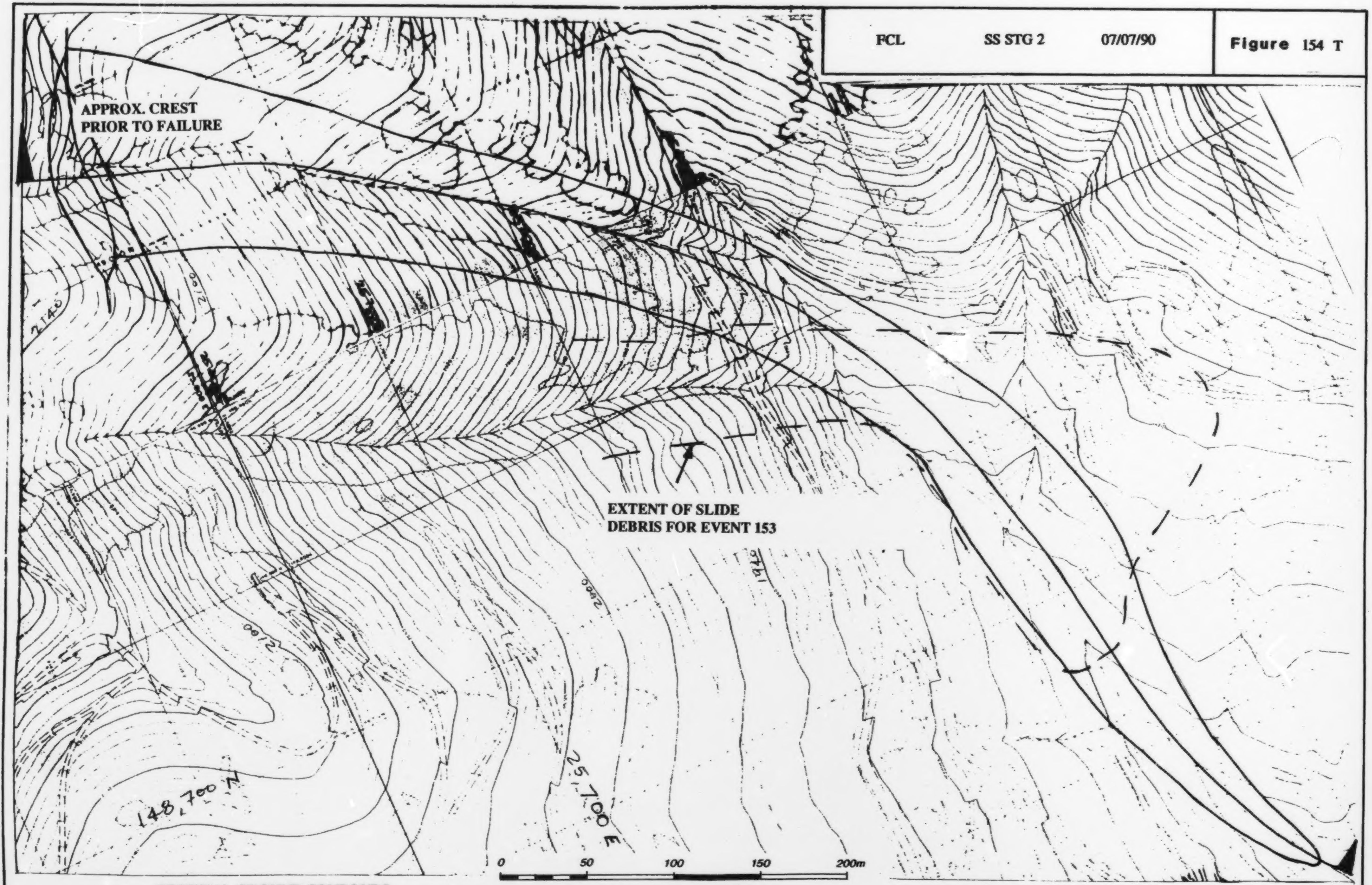


PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

Golder Associates

FCL SS STG 2 07/07/90

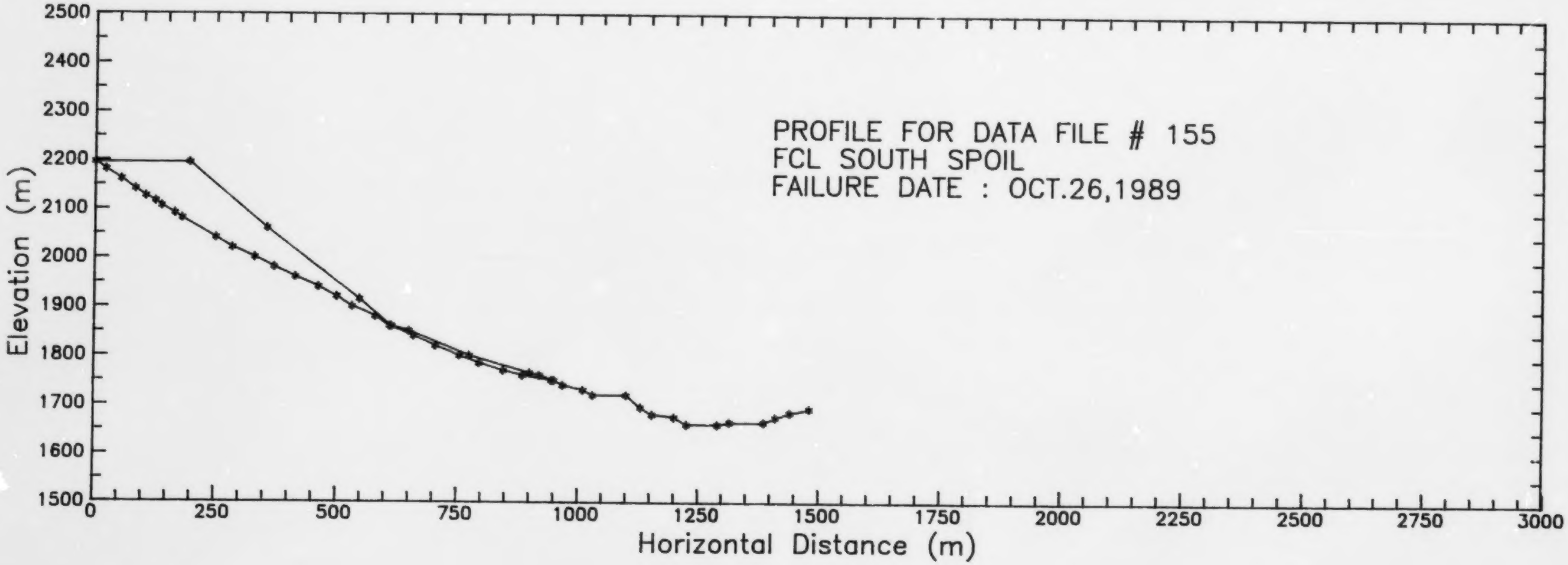
Figure 154 T


APPROX. CREST
PRIOR TO FAILURE
EXTENT OF SLIDE
DEBRIS FOR EVENT 153
2140
2100
2100
2000
2000
1960
148,700 N
25,700 E
0
50
100
150
200m
Approx. Scale : 1 : 2000

ORIGINAL GROUND CONTOURS

PROJECT NO. .... DRAWN .... REVIEWED ....

FCL **SOUTH SPOIL** **10/29/89** **Figure 155 S**



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. '91

FCL	SOUTH SPOIL	10/29/89	**Figure** 155 P

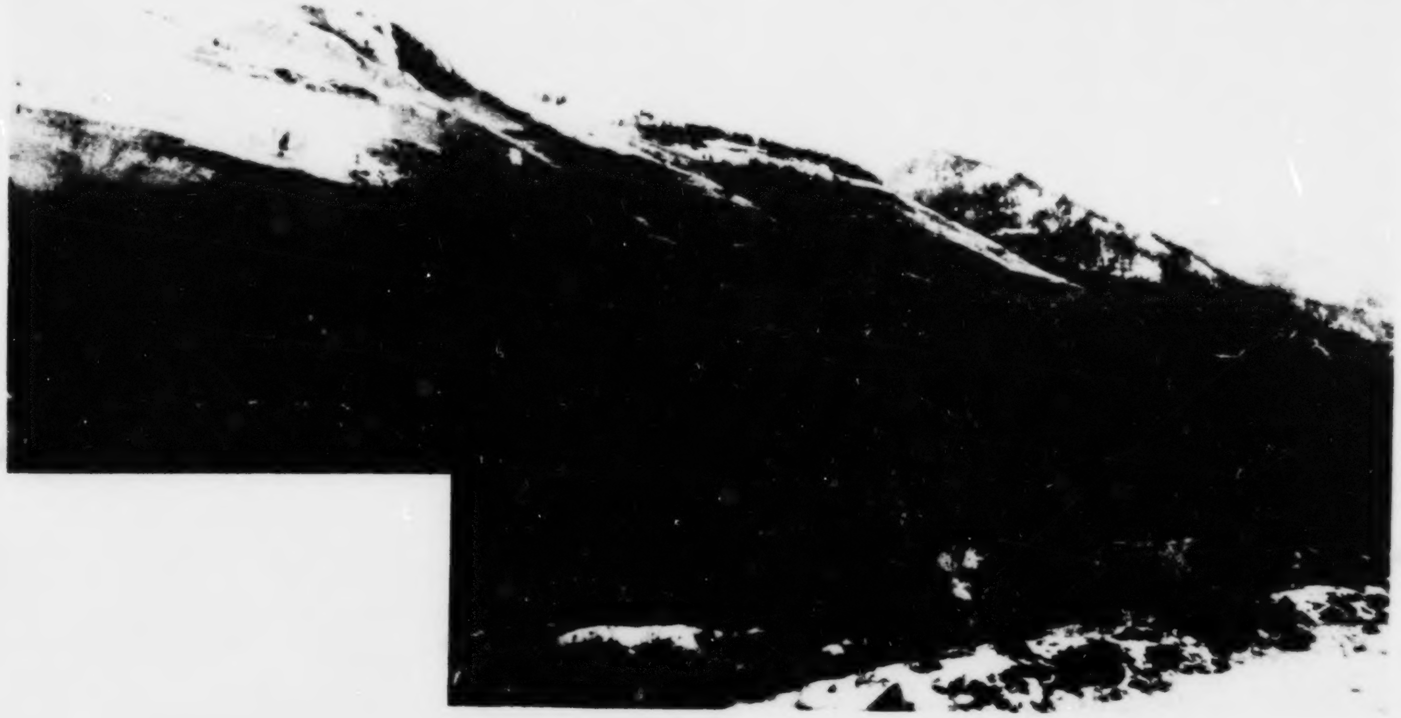


Photo 1 - Side view of spoil pile movement. Note (1) Steep upper scarp. (2) Uniform upper parallel sloped to top of Blackwood Pit. (3) Runout area in the valley bottom. The material developed high velocity and scoured the terrace top and valley bottom. The present conditions provide better spoil pile foundations than previously.

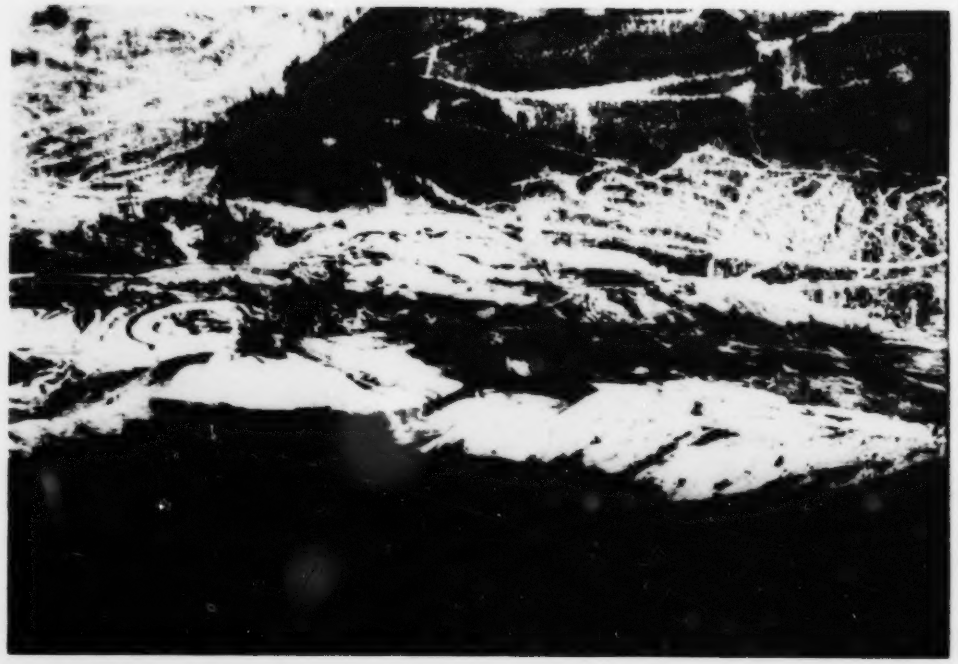


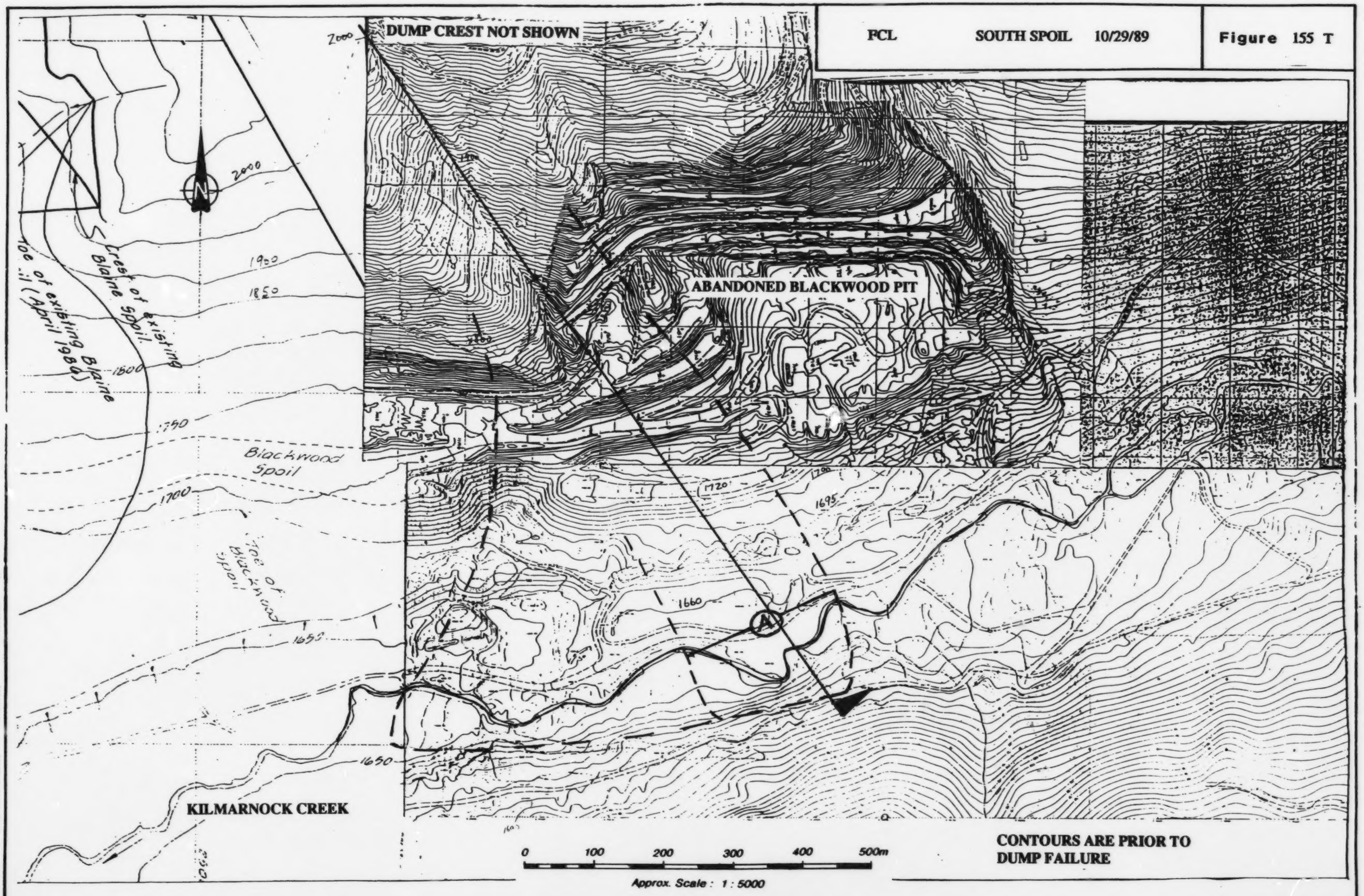
Photo 6 - Toe runout zone looking from above. The toe ran up the far mountain as a result of the velocity. The spoil appears to have ski jumped off the creek terrace and possibly liquified when it encountered the valley bottom softer and wetter sediments. The toe acted mach like the toe of the Hope-Princeton rock slide when it hit the valley bottom. The valley bottom is now obviously more stable.

From report by C. Brawner to Fording Coal Ltd. November 14, 1989

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

FCL SOUTH SPOIL 10/29/89

Figure 155 T

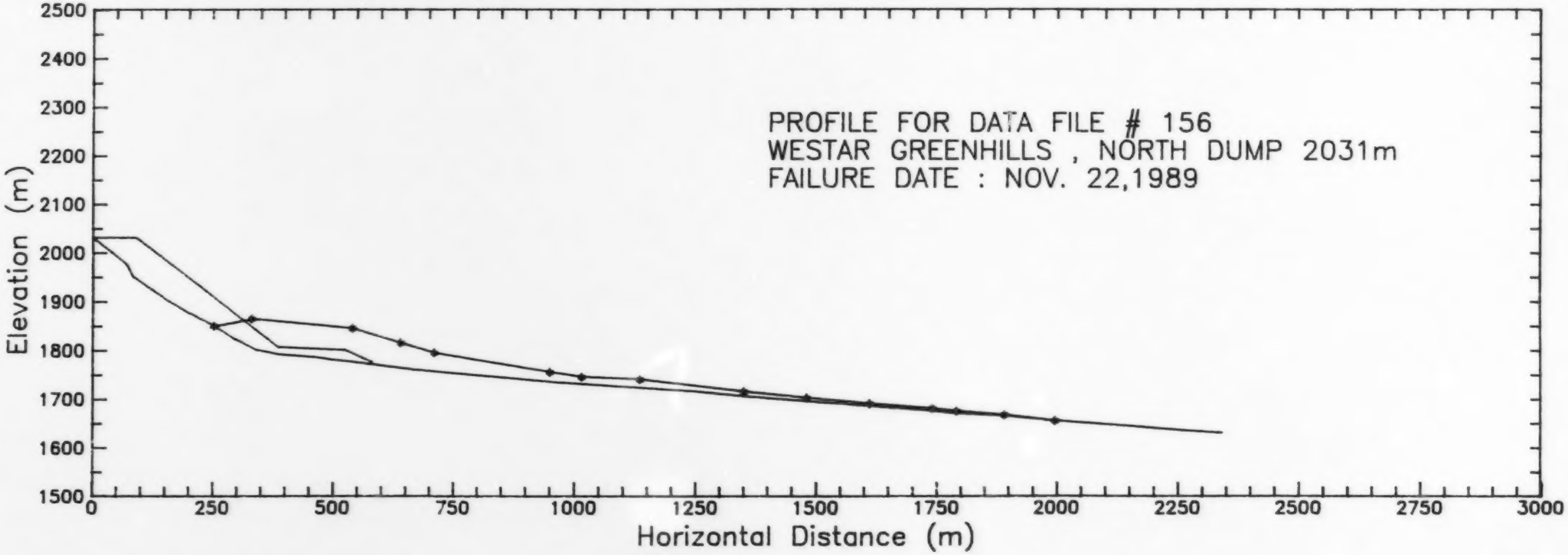

2000
DUMP CREST NOT SHOWN
N
2000
Crest of existing Blaine Spoil
Toe of existing Blaine Spoil (April 1986)
1900
1850
1800
1750
Blackwood Spoil
1700
Toe of Blackwood Spoil
1650
1650
ABANDONED BLACKWOOD PIT
1720
1700
1695
1660
A
KILMARNOCK CREEK
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

CONTOURS ARE PRIOR TO DUMP FAILURE

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

GREENHILLS NORTH 11/22/89

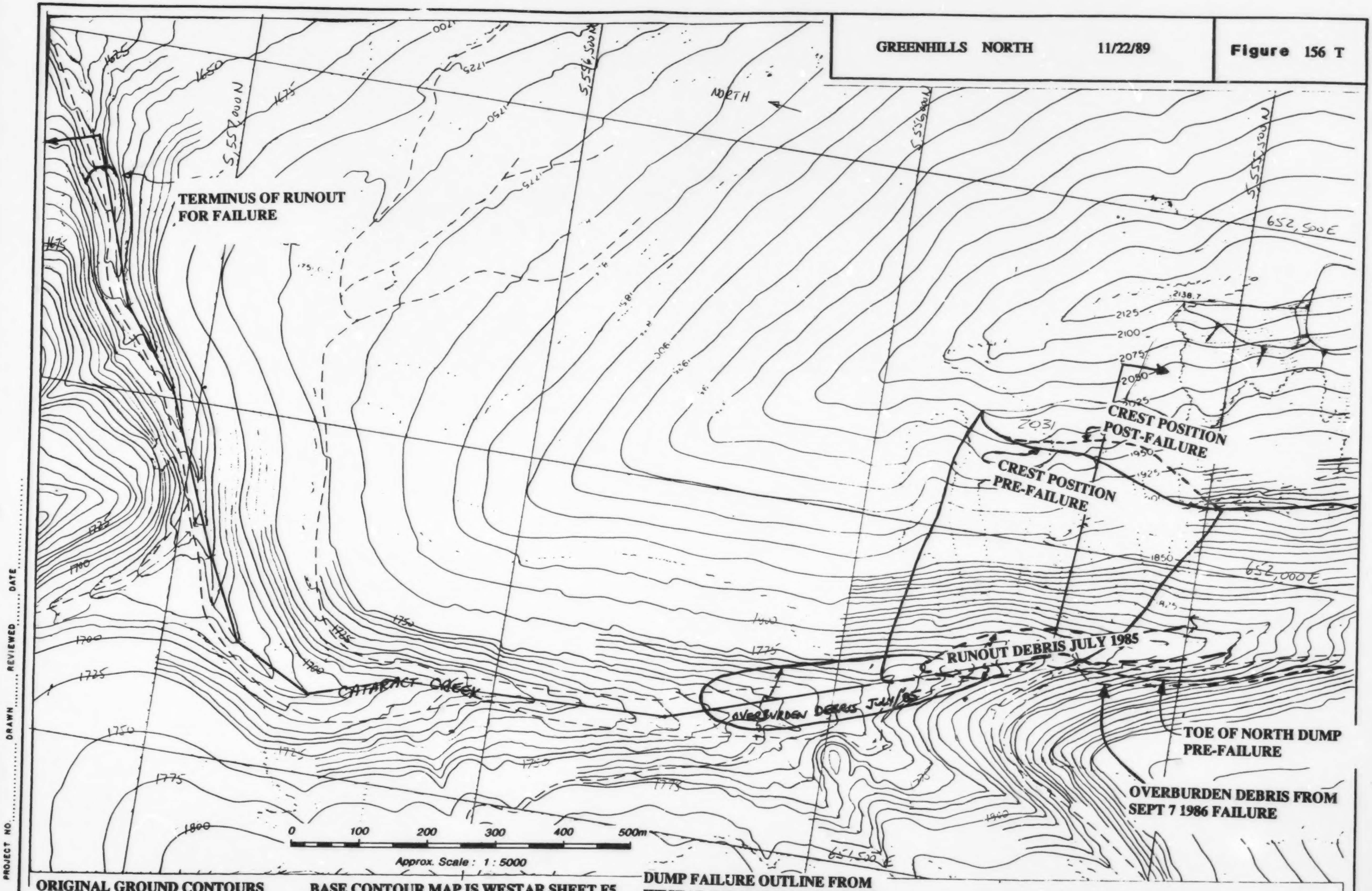
Figure 156 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. 91

GREENHILLS NORTH 11/22/89

Figure 156 T


TERMINUS OF RUNOUT FOR FAILURE
CREST POSITION POST-FAILURE
CREST POSITION PRE-FAILURE
RUNOUT DEBRIS JULY 1985
OVERBURDEN DEBRIS JULY/85
CATARACT CREEK
TOE OF NORTH DUMP PRE-FAILURE
OVERBURDEN DEBRIS FROM SEPT 7 1986 FAILURE
NORTH
5,557,000 N
5,556,500 N
5,556,000 N
5,555,500 N
652,500 E
652,000 E
651,500 E
1625
1650
1675
1700
1725
1750
1775
1800
1850
1875
1900
1925
1950
2025
2031
2050
2075
2100
2125
2138.7
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

ORIGINAL GROUND CONTOURS

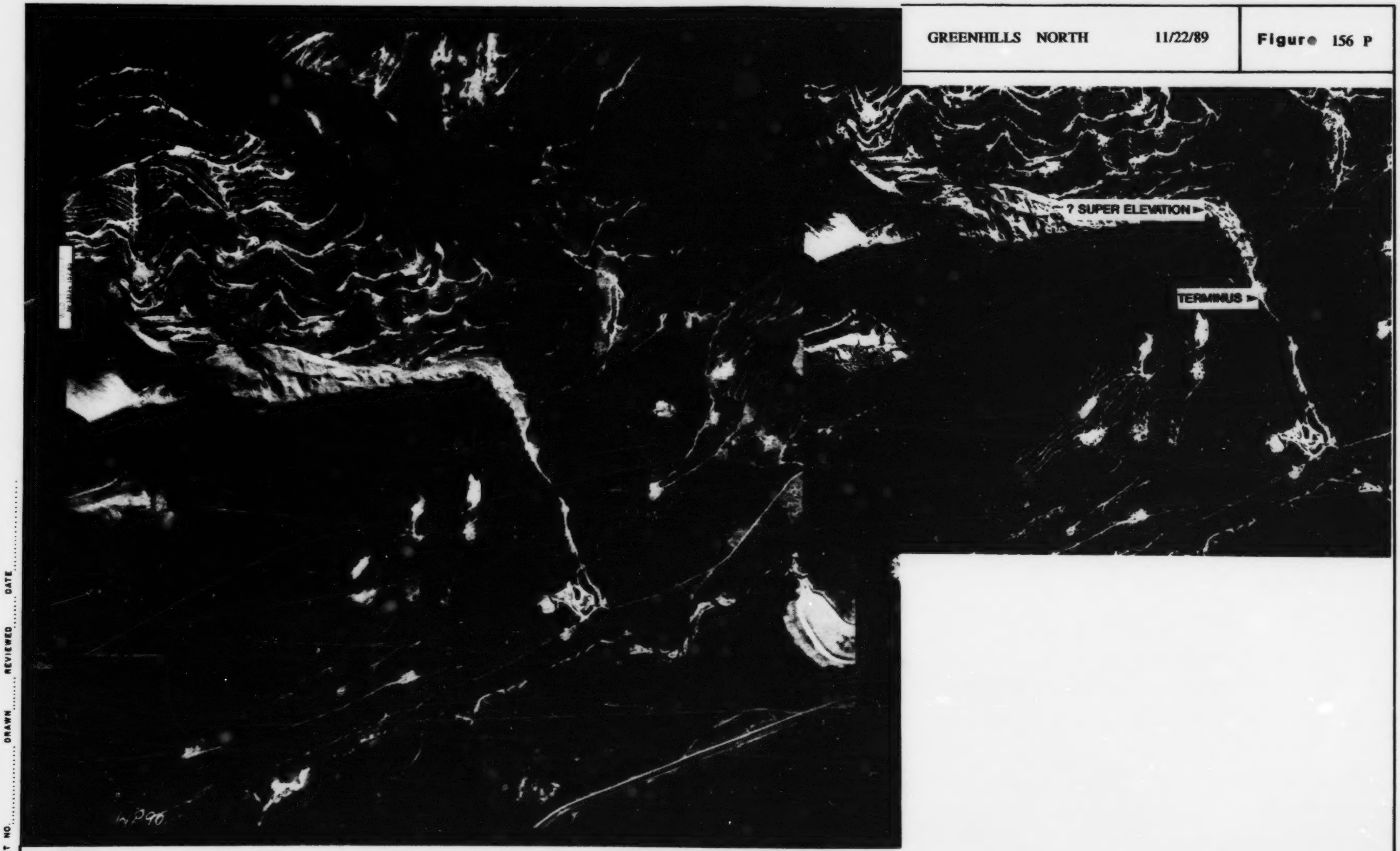
BASE CONTOUR MAP IS WESTAR SHEET F5

DUMP FAILURE OUTLINE FROM WESTAR DWG NO 541 NOV 23 1989.

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

GREENHILLS NORTH 11/22/89

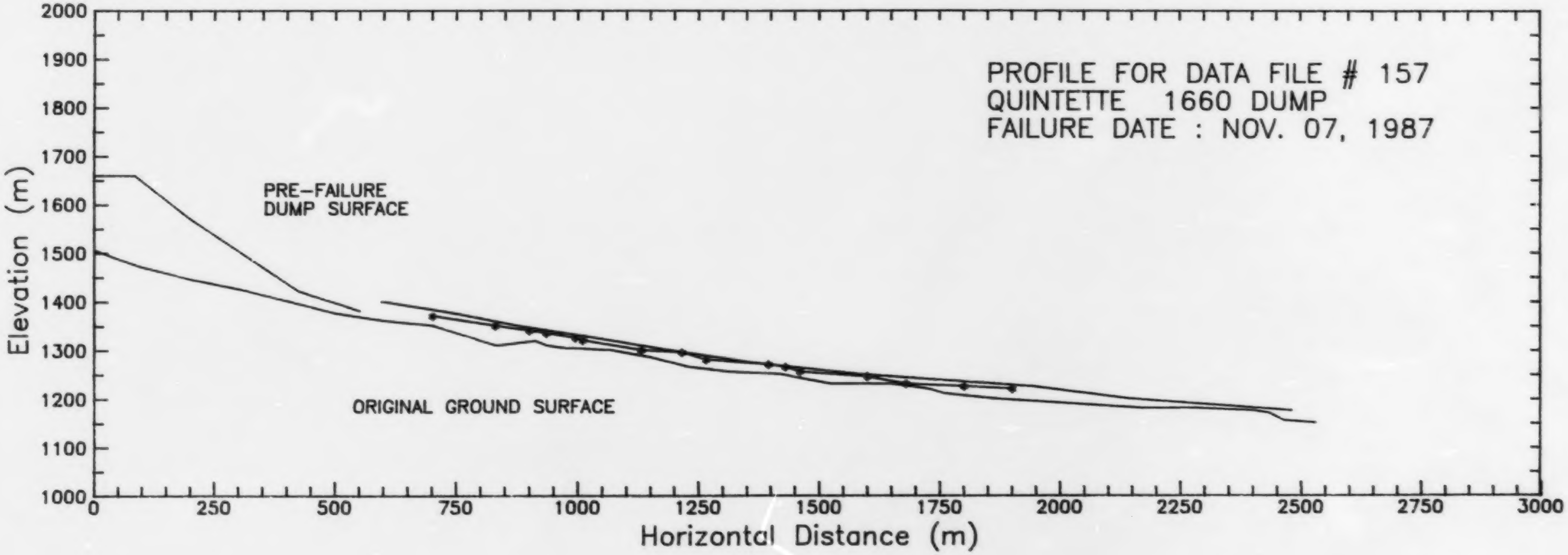
Figure 156 P


? SUPER ELEVATION
TERMINUS
w P90

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

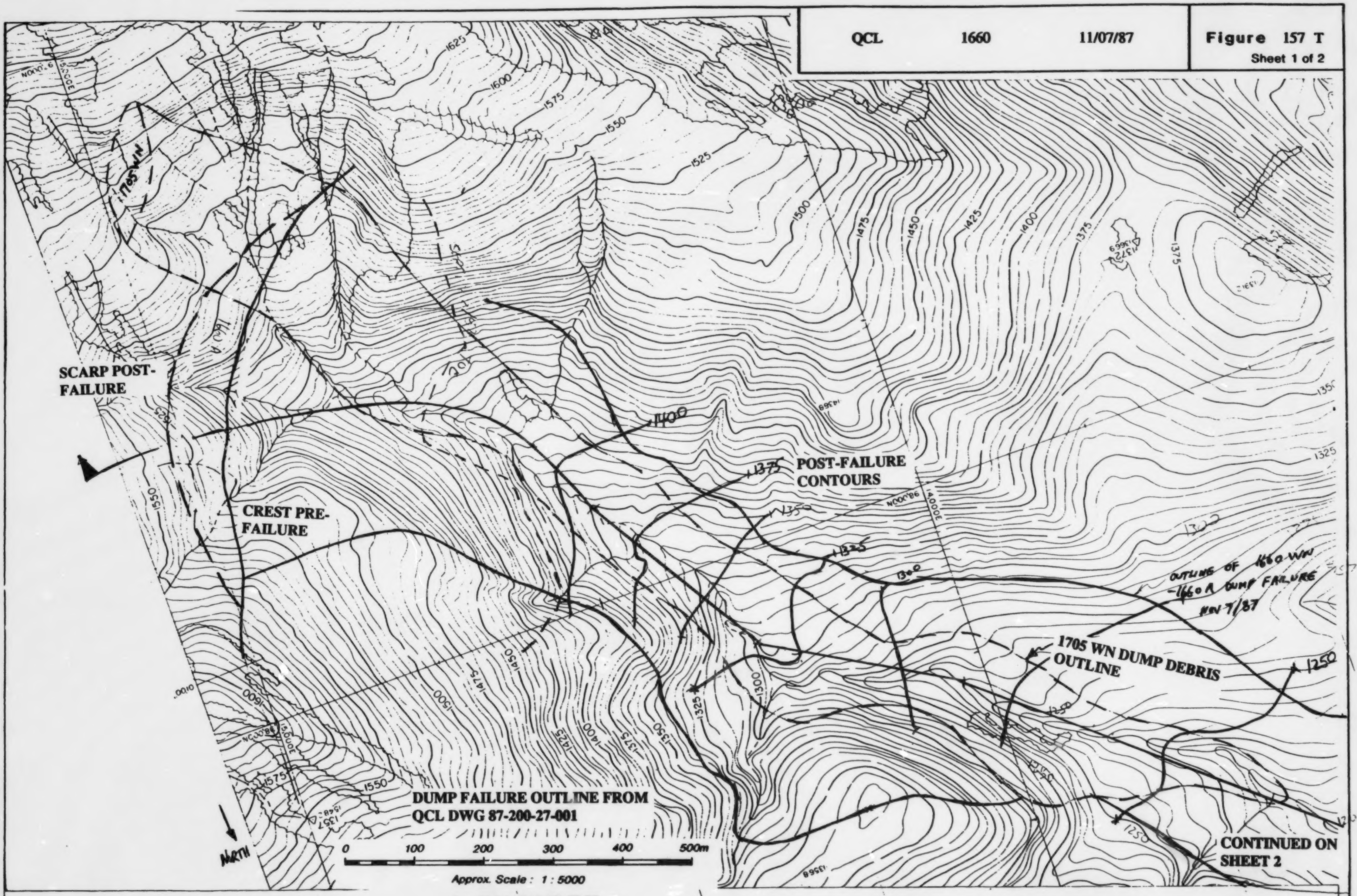
GEOGRAPHIC AIR SURVEY LTD.
17 AIRPORT ROAD, MUNICIPAL AIRPORT, EDMONTON, ALBERTA [illegible]

QCL	1660	11/07/87	**Figure 157 S**



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept. 91

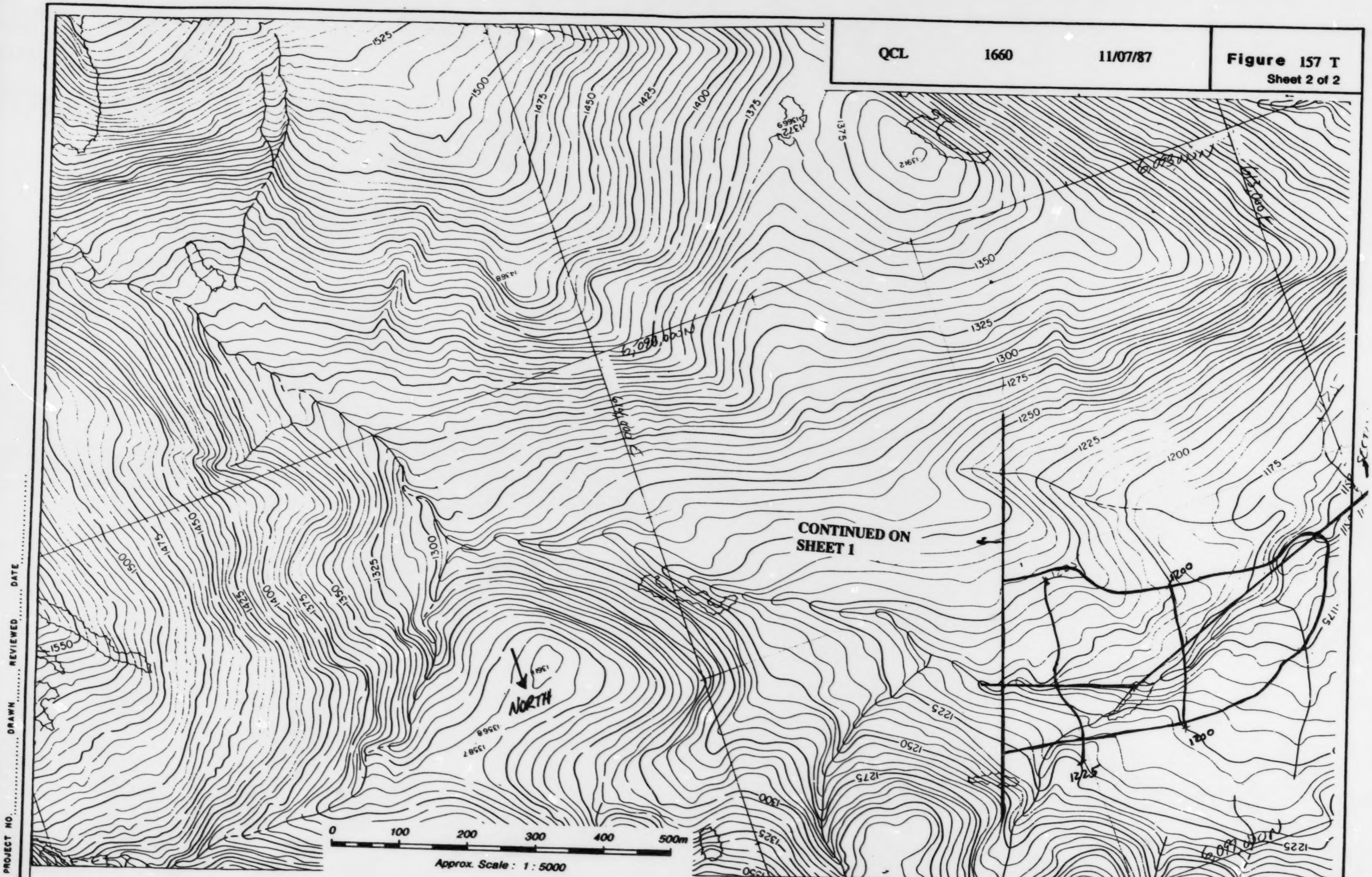
QCL	1660	11/07/87	Figure 157 T Sheet 1 of 2


SCARP POST-FAILURE
CREST PRE-FAILURE
POST-FAILURE CONTOURS
1705 WN DUMP DEBRIS OUTLINE
OUTLINE OF 1660 WN -1660 R DUMP FAILURE NOV 7/87
DUMP FAILURE OUTLINE FROM QCL DWG 87-200-27-001
CONTINUED ON SHEET 2
1705 WN
1660 R
NORTH
1625
1600
1575
1550
1525
1500
1475
1450
1425
1400
1375
1350
1325
1300
1250
0 100 200 300 400 500m
Approx. Scale : 1 : 5000

BASE MAP QCL Y-31

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

QCL	1660	11/07/87	**Figure 157 T** Sheet 2 of 2

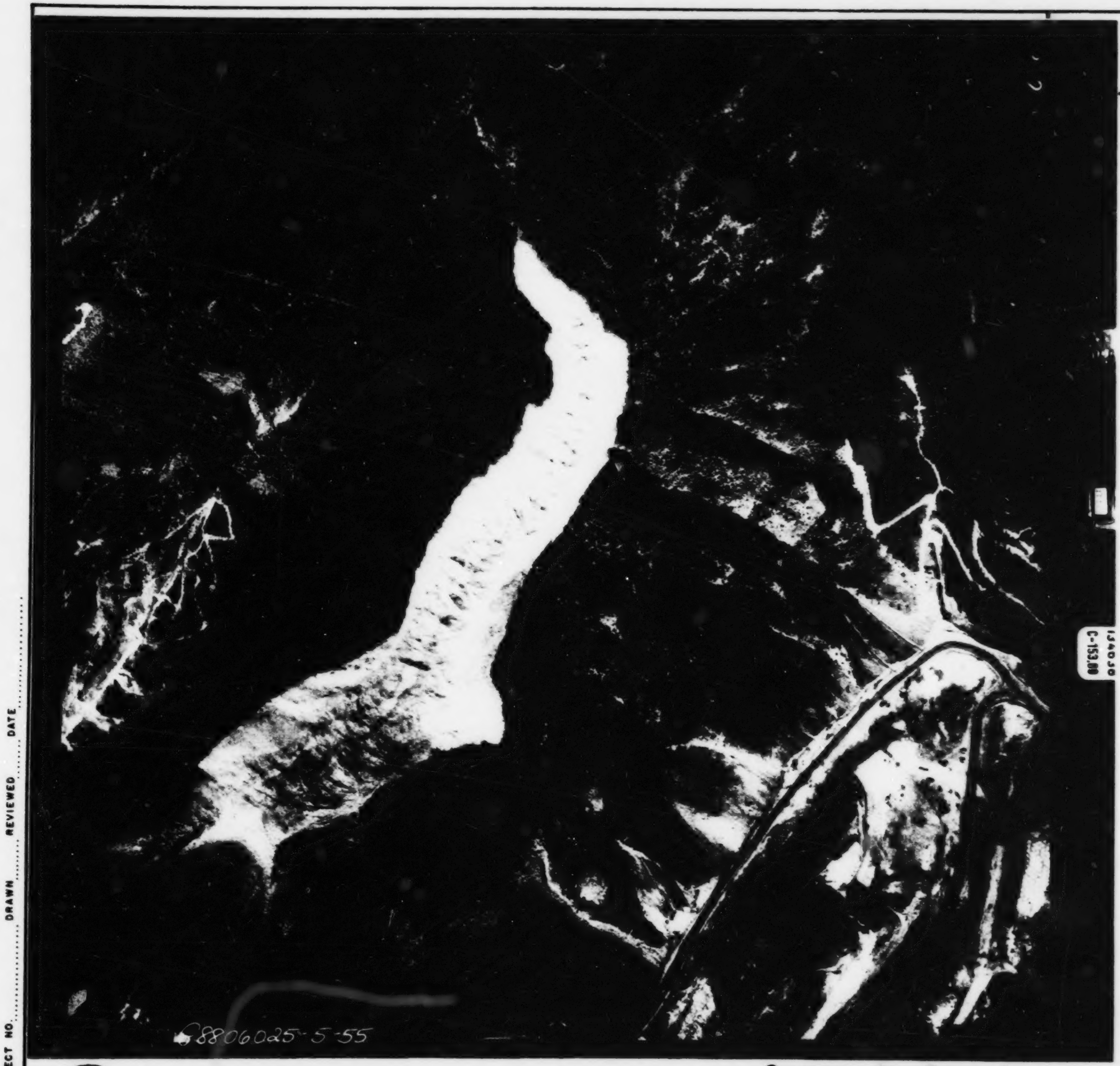


1525
1500
1475
1450
1425
1400
1375
1372
1366.9
1391.2
1350
1325
1300
1275
1250
1225
1200
1175
1550
1336.8
1356.8
1358.7
1361
NORTH
1200
1225
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

CONTINUED ON SHEET 1

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

QCL	1660	11/07/87	**Figure** 157 P

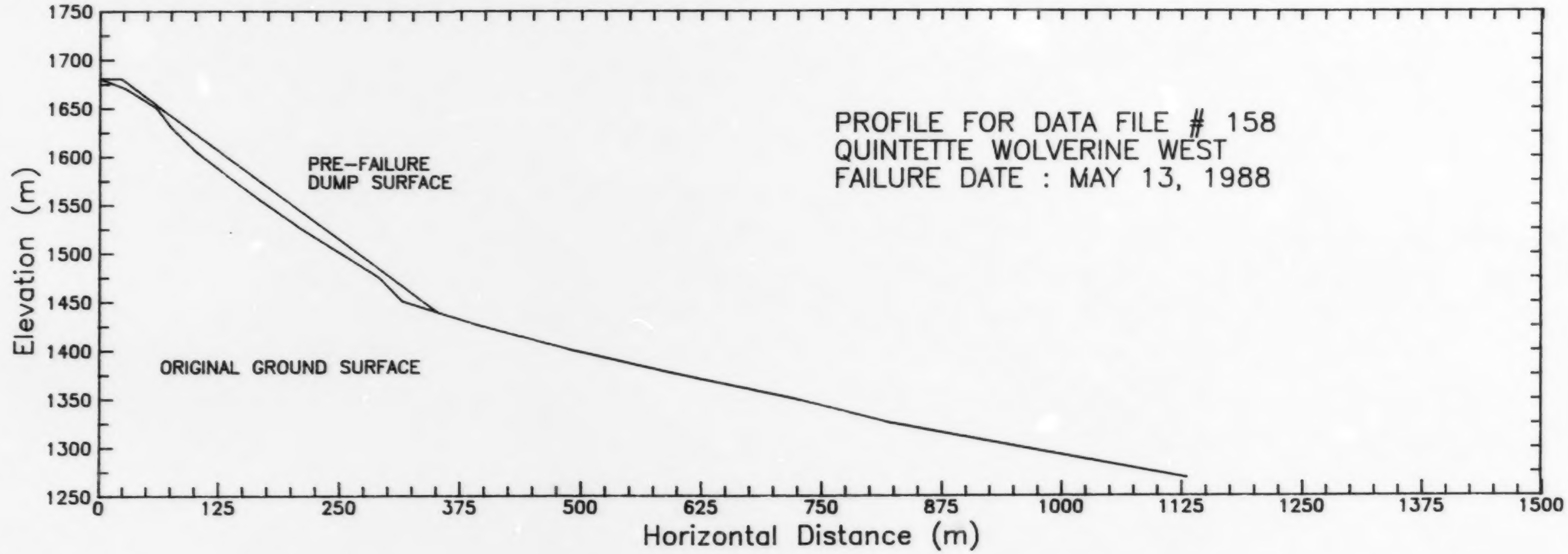

134030
C-153.00
G8806025-5-55

GEOGRAPHIC AIR SURVEY LTD.
17 AIRPORT ROAD, MUNICIPAL AIRPORT, EDMONTON, ALBERTA T5G 0W6 (403) 451-1405

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

QCL 1680 WW 05/13/88

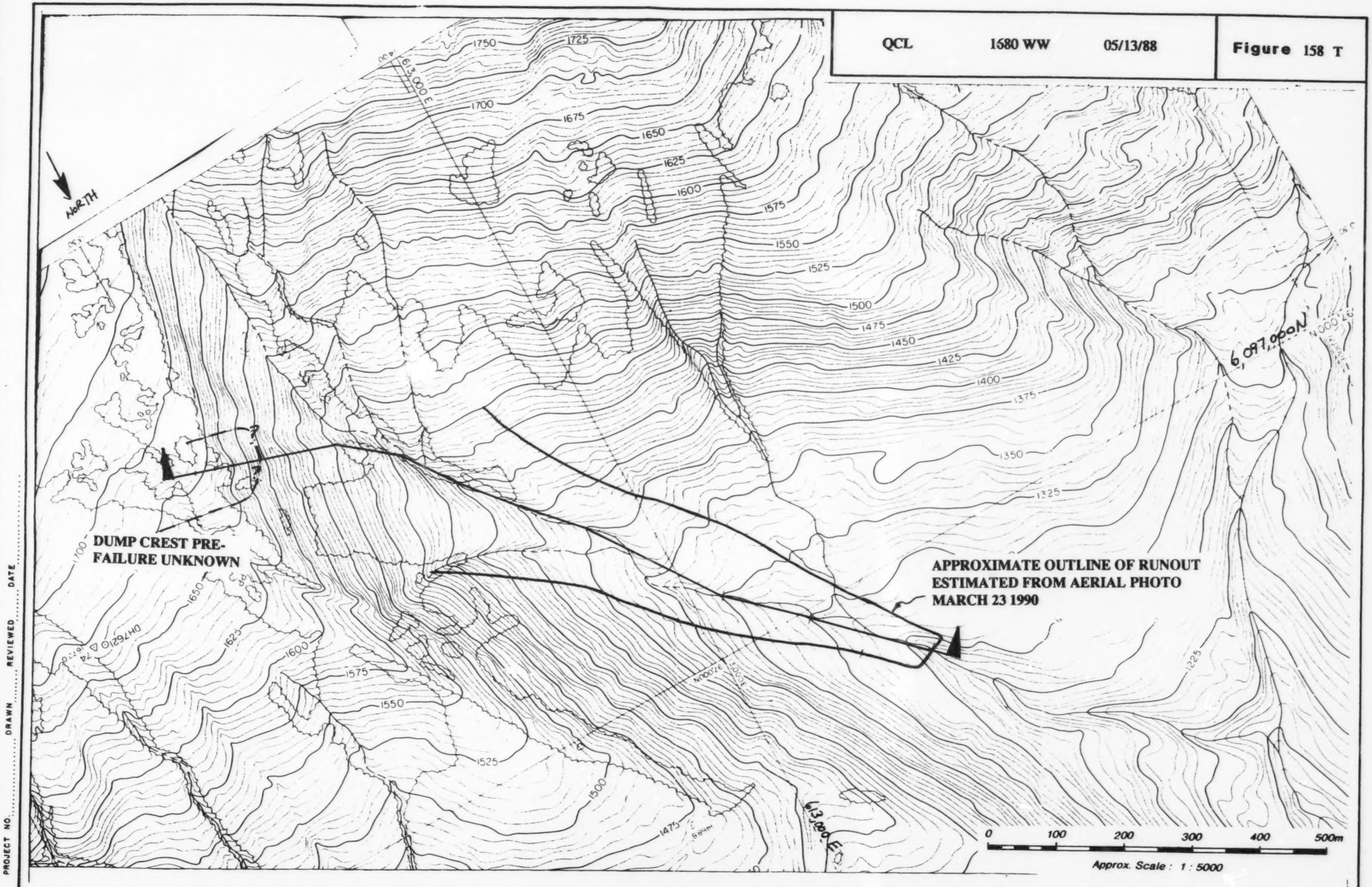
Figure 158 S



PROJECT NO. 912-1413 DRAWN .... REVIEWED .... DATE Sept '91

QCL 1680 WW 05/13/88

Figure 158 T

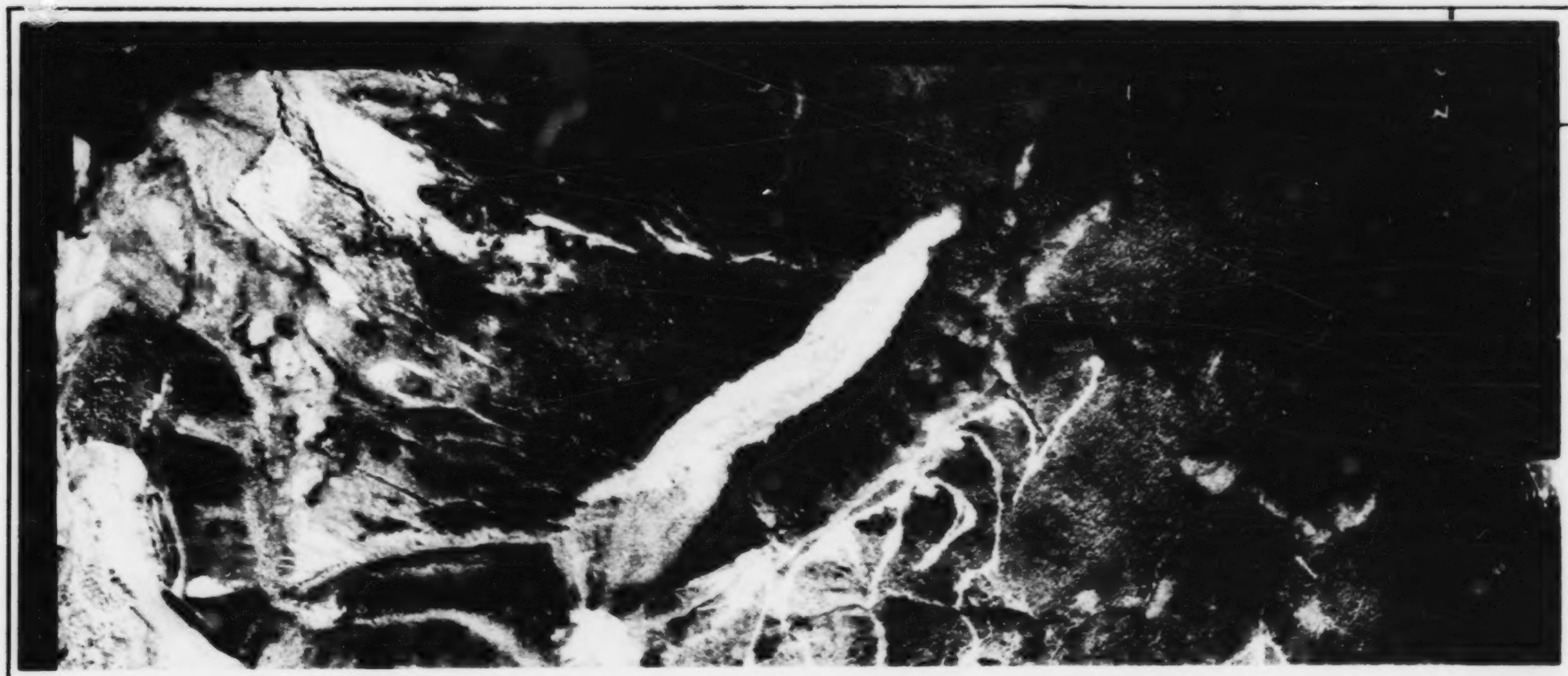

NORTH
1750
1725
1700
1675
1650
1625
1600
1575
1550
1525
1500
1475
1450
1425
1400
1375
1350
1325
1225
613,000 E
6,097,000N
DH76210 ▽ 74
884m
0
100
200
300
400
500m
Approx. Scale : 1 : 5000

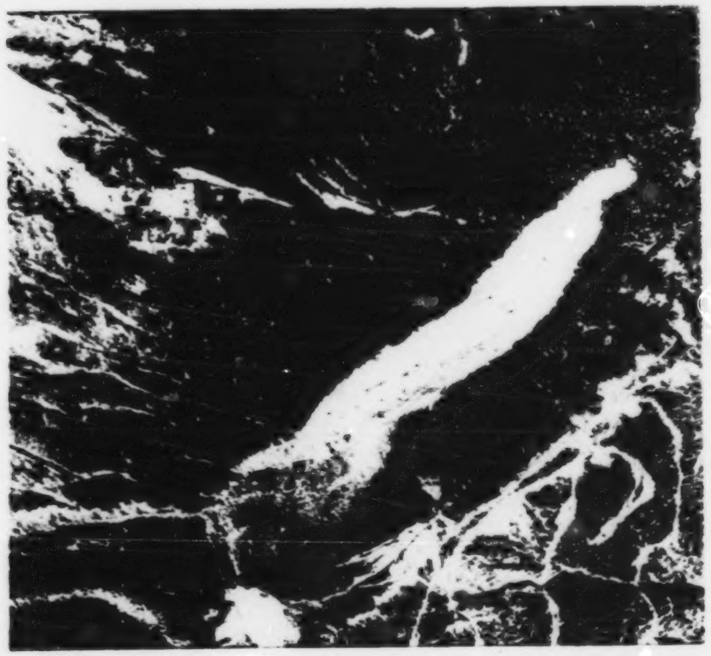
DUMP CREST PRE-FAILURE UNKNOWN

APPROXIMATE OUTLINE OF RUNOUT ESTIMATED FROM AERIAL PHOTO MARCH 23 1990

PROJECT NO. ________ DRAWN ________ REVIEWED ________ DATE ________

QCL 1680 WW 05/13/88 **Figure** 158 P





A view looking in the down-valley direction, showing the debris run that resulted from the 12 May 88 failure on the face of the Wolverine West Dump, and the right valley wall. The surficial colluvial soil mantle on the right valley wall is thin, and is only quasi-stable on the slope.

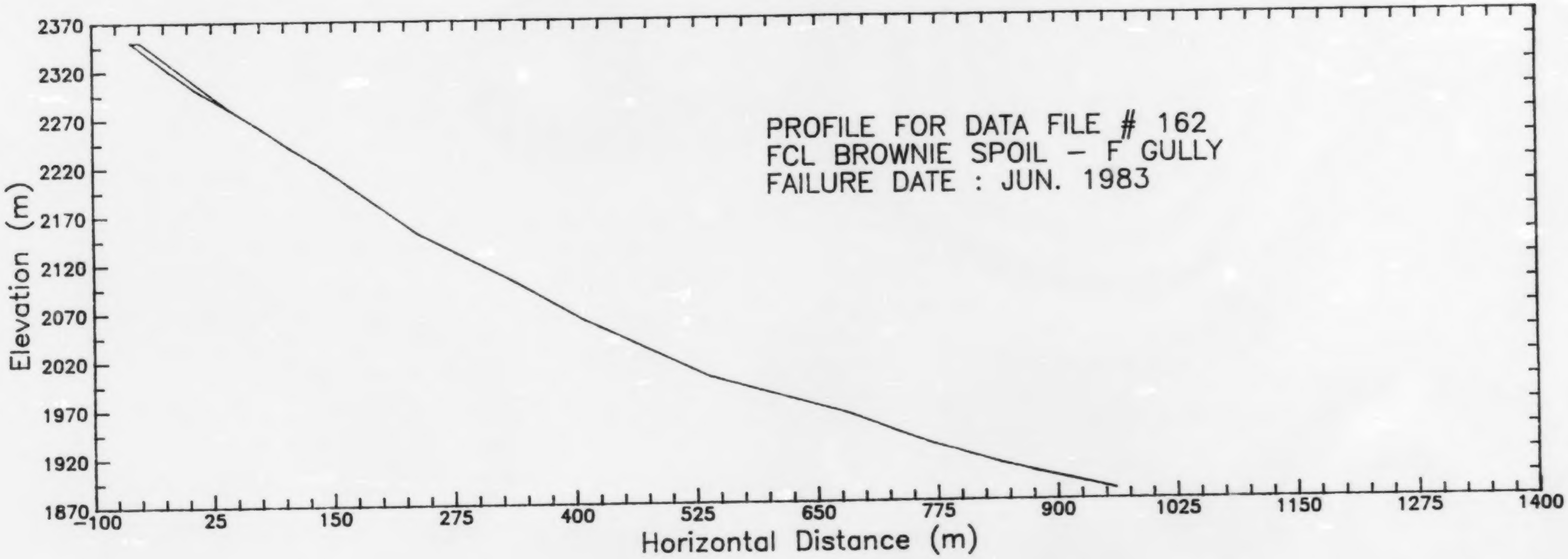
The inclination of the slope on the right valley wall is controlled by the inclination of a major set of cross joints. The strike of the sedimentary units is approximately parallel to the axis of the valley. The stratigraphic dip is toward the right hand side of the photo.

From Golder Associates report 882-1146A Aug. '88.

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

FCL **BROWNIE** **JUN1983**

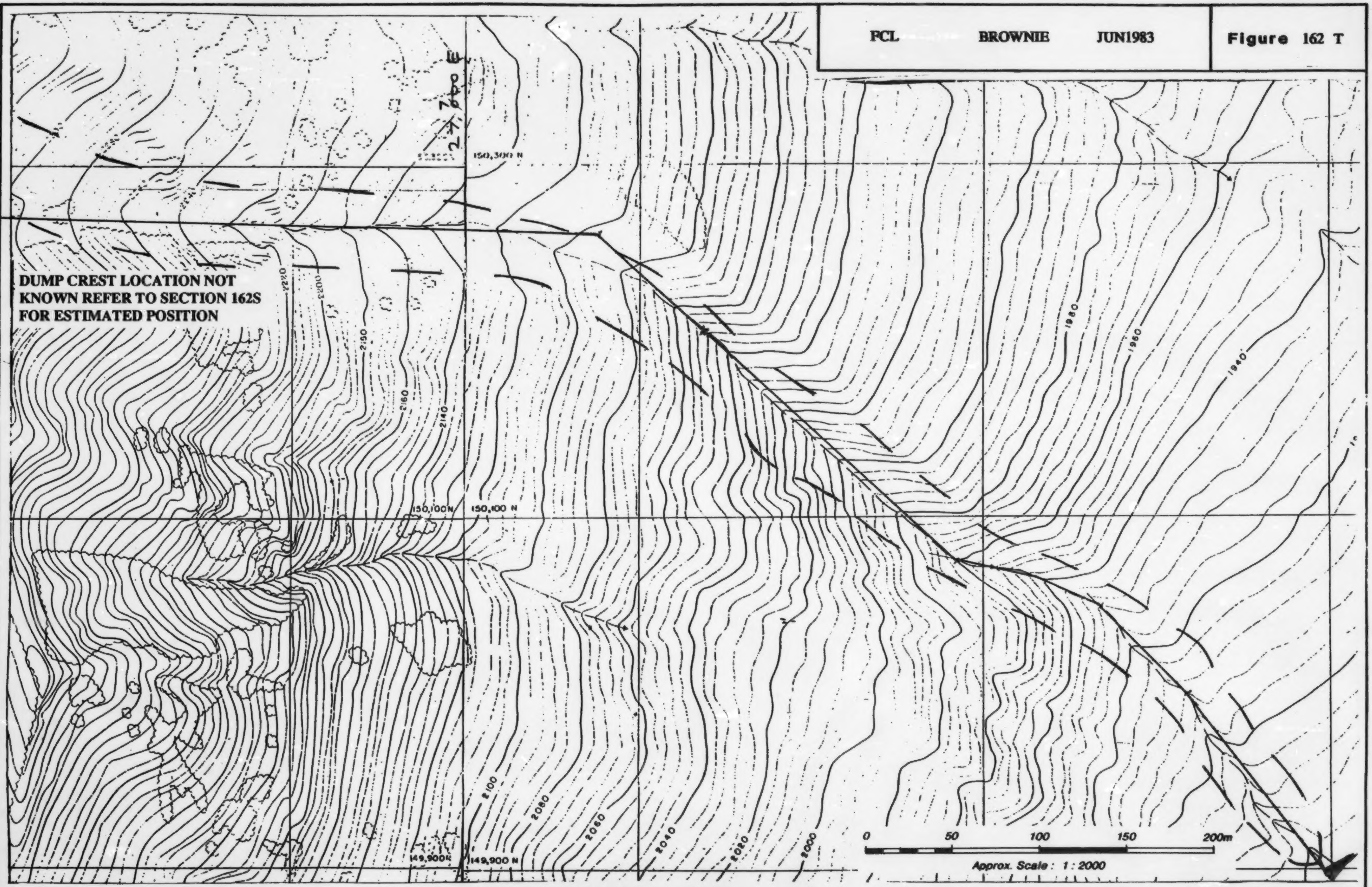
Figure 162 S



PROJECT NO. 912-1413 DRAWN ...... REVIEWED ...... DATE Sept. '91

FCL **BROWNIE** **JUN1983**

Figure 162 T


2?,700 E
150,300 N
150,100 N
150,100 N
149,900 N
149,900 N
2220
2200
2150
2160
2140
2100
2080
2060
2040
2020
2000
1980
1960
1940
0
50
100
150
200m
Approx. Scale : 1 : 2000

DUMP CREST LOCATION NOT
KNOWN REFER TO SECTION 162S
FOR ESTIMATED POSITION

CONTOURS ARE ORIGINAL GROUND

PROJECT NO. .... DRAWN .... REVIEWED .... DATE